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FIRST HONORABLE MENTION.

THE ELEMENTS OF FLEET TACTICS.

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Motto: *"For now we see through a glass darkly."*

The principles which govern military operations on shore are well understood and have undergone few changes from century to century. Master minds have long since formulated the principles of land fighting, and the world has recently seen a Field Marshal of Japan, educated in youth in the military arts of the Middle Ages, a master of the science and art of war on land in its highest modern development. In naval tactics, on the other hand, we find only a few desultory pamphlets as an offset to the libraries written on the military art of war. The reason is not far to seek. Man's natural element is the land. Sea life is artificial. Every step in naval progress is the result of the application of scientific principles in overcoming man's limitations afloat, with the result that naval tactics have been, from century to century, profoundly modified by the advance of science to the undoing of those students who have looked too confidently to the history of the past as furnishing the key to the naval tactics of the present day.

To illustrate this:—

With the limited range of bows, arrows, javelins, pikes, and swords, and with oars as a motive power, we find, in the *Galley Period* the ram as the greatest weapon of destruction. The tactics were largely those of armies, as ships were generally commanded by military men. The weapons were of short range, and battles were decided by ramming and boarding, *i. e.*, by direct contact.

With the general adoption of gun powder, and with sails as the motive power, the ram disappears and the supreme weapon is the gun, but the musket, the pistol, and the hand grenade, as well as the pike and cutlass, are the successors of the hand weapons of the galley period for use in close action. In this, the *Sail Period*, guns were mounted in broadside, the bow and stern fire being necessarily very limited. In this period the great naval commanders flouted army or military tactics, the great advantage being sought in the weather gauge and in breaking the enemy's line. Owing, however, to the limited range of the guns, and the obscurity caused by their smoke, battles were either decided by gun fire, or by boarding, which latter involved direct contact.

With the advent of steam the ram was revived, but in conjunction with the broadside fire of the sail period, sails being retained as an additional motive power other than in action. At this period the torpedo appeared in its simplest form, the floating mine, and with that combination of the ram and mine known as the "Spar torpedo." In this, the *Steam-Wood Period*, the obscurity caused both by gun fire and coal smoke gave the ram its opportunity, and battles were decided either by gun fire or by ramming, which latter involved direct contact.

Crowding on and overlapping this period came the *Steam-Iron Period*, in which iron replaced wood, the rifle replaced the smooth bore in the main batteries of ships, while bow and stern fire became the more noticeable as sail power became more and more auxiliary to steam. At this time the towing and the dirigible torpedo briefly flourished, and made ramming more and more dangerous. Direct contact now disappears except as a remote or alternate method of settling sea fights. With the gradual substitution of steel for iron, began the present, the *Smokeless Period*, with the high powered rifle, telescope sights, smokeless powder, face hardened armor, capped projectiles, search lights, automobile torpedoes, torpedo boats, triple screws, water tube boilers, enormous horse power, the

submarine, the disappearance of sail power, the advent of the turbine engine, and the gradual increase of the bow and stern fire with no diminution of broadside fire. The dynamite gun rose and fell. Each new invention in this period has carried a threat to "revolutionize naval warfare," but, in the readjustment of our ideas from time to time, the gun has remained supreme, the torpedo ranking second as the weapon of both offense and defense, and the ram has been relegated to third place as the weapon of the offensive-defensive. In the war between Japan and Russia, we find the successful reversion to tunneling and mining in siege operations on shore against a fortified base, and the floating mine in blockade operations, as in our Civil War of 1861-5. Thus we see that the weapons of naval warfare have changed from time to time, have disappeared, and then returned again, yet the human factor has remained very much the same.

This brief and not altogether accurate historical summary at least shows why we sometimes feel that, in the study of naval tactics, we are groping and find it difficult to get on solid ground, but we can never really understand naval tactics until we clearly grasp wherein lies the elementary difference between naval tactics and military tactics. However much they may resemble each other in grand tactics or in the strategy of campaigns, in minor tactics, as here discussed, there is a wide difference.

MILITARY TACTICS VS. NAVAL TACTICS.

A crab, on the offensive, moves forward presenting its claws to the attack. When hard pressed and put on the defensive, it moves backwards but still presents its claws. It can side step with equal facility. As much as we may admire the crab in simplicity of its tactics, we must admit that it has its limitations when picked up by its rear end. Operating in its natural element the tactics of the crab remain immutable. Tactically speaking, man is a good deal of a crab. With all the remarkable advance in weapons, from the club of primitive man to the modern high-powdered rifle, man has never been able to fight to the rear without facing about, and when firmly grasped by the collar of his coat and the seat of his trousers is as immutably helpless as our friend the crab. Even artillery on wheels and man on horseback are practically limited to fighting to the front with the necessity of facing about to fire to the rear. To use a nautical term, land

fighting is a question of bow fire. When in battle formation, a flank attack masks most of the fire and requires the defense to draw back to meet it. It would appear, primarily, that an army formed in a circle would be better able to meet an attack from any direction, but that is exactly the one formation it cannot take, for its very existence depends upon it protecting its line of communications. Threaten that, or make a flank attack, and it must turn and fight. If the flank attack is successful the whole army must retreat in order to cover the line of communications. The Battle of Mukden illustrates this, as indeed does nearly every decisive battle. The nearer an army in the field is driven towards a circular formation the more perilous is its position. In a fortified town, under siege, cut off from outside communication, the garrison has its base of supplies with it.

Another consideration which profoundly modifies military tactics is that of topography. To take advantage of favorable topographical conditions, or, by military engineering, to so alter and improve them is a large part of the problem of the soldier, but with all the advance in weapons, tools, paraphernalia, and the mechanical transmission of information and orders, military tactics have changed very little from century to century, except in adaptations and modifications of a minor character.

But man afloat in the modern battleship is no longer the crab. It is true that the weapons of the soldier are furnished him, but in action they are merely kept at hand in case of the last resort. He is there as the eyes, brain, nerves, and sinews to give life to a mechanical monster, which, without him, is a mass of inert elements. Behind armor protection he carries his camp, baggage, artillery, commissariat, ammunition, and reserve. Lines of communication, in the strict sense, there are none. He may even dispense with a base of supplies for long periods by having supply ships and other *impedimenta* accompany him. His ships have all-around fire, although the bow and stern fire are not so strong as that of broadside. By the mobility of the units of his battle formation, flank attacks can be successfully delivered against him only by his ignorance, carelessness, or helplessness. Topography comes in only where sea fights take place close to land or in narrow waters. In the open sea, a level plane, there are choice positions in action, but only with regard to sunlight, or the wind, or the state of the sea, or the distance at which it is desired to engage.

If we therefore dismiss from our minds, for the moment, all thought of military tactics and take up the consideration of naval tactics from first principles, we will save ourselves much confusion of thought. Later on we may accept such principles of military tactics as can be clearly shown to apply.

THE BASIS OF NAVAL TACTICS.

Reduced to its simplest terms a battleship is a floating gun-platform which, on a given displacement, has the maximum of concentrated destructive power for battle, in all conditions of wind and weather, on the high seas. Many battleships satisfy all the conditions only to a limited degree. For maximum destructive power the ram and the torpedo should supplement the gun, even assuming that the torpedo and ram are tactically the weapons of the defense, or, speaking more accurately, of the offensive-defense, and even granting that they merely, by their existence, affect the tactics of the gun. The gun is essentially the weapon of naval warfare, and on the tactics of the gun we must base naval tactics, subject to such modifications as the torpedo and the ram may impose.

It will clear the problem very much if we recognize that the difference between the tactical values of battleships and of all other classes of naval vessels is merely one of degree rather than of kind, because the others merely take some one weapon and some one quality of the battleship and sacrifice almost everything else, but the battleship dictates the special tactics which the others *may* use. Cruisers, torpedo-boats, and armored rams *must* have exaggerated speed to avoid encountering battleships unwillingly or in order to deliver their blow in the shortest possible time so as to escape as much gun fire as possible. Submarines or submersibles *must*, for the same reason, remain invisible as long as possible. Monitors *must* have smooth water because they are wretched gun platforms.

On the other hand these special classes of naval vessels react upon the design of the battleship, requiring it to have quick manœuvreing qualities, powerful secondary batteries, search lights, nets, and other auxiliary appliances, but for all that the question of the tactics of the battleship, that is of naval tactics pure and simple, is primarily that of gun against gun and armor against armor, on the high seas.

If we therefore examine the installation of guns in the more recent battleships, built or building, we will note, as important, the gradually increasing development of bow and stern fire without a corresponding dimunition in the effective broadside fire. This has largely been accomplished by the increased calibre of guns and their concentration in turrets or heavily armored barbettes. Nor will the movement probably end until we have the battleship with only 12-inch guns in the main battery and 4-inch and fifteen pounders in the secondary battery. This increase in bow and stern fire, combined with the gradual extension of armored areas to all parts of the ship occupied by the personnel in action, has greatly simplified fleet tactics. While it is with conditions and not with theories that we must deal, we must nevertheless look ahead in our tactics to meet conditions which seem theoretically inevitable. One feature to be reckoned with is the enormous increase in range and accuracy of the automobile torpedo, but this affects tactics by increasing the range of fleet tactics. This in turn increases the importance of large calibre guns.

While the individual gun is the real unit of offense, we may state it as a tactical axiom:—

Axiom 1. *The combined fire of as many guns as possible, concentrated according to a definite plan, by means of a well directed fire control, is the essence of naval warfare and the true basis of naval tactics.*

The armor protection of our ships and that of the enemy opposed to us is of importance, but when we make sure that our own fire is delivered to its best advantage as regards rapidity, accuracy, and *character of projectiles,* we may let the question of armor protection work itself out in practical results in battle, because gun fire is itself the best protection against gun fire.

Superiority in gun fire may be in the size and number of guns; it may be in the greater rapidity and more accurate shooting of a lesser number of guns; or still deeper it may be in the superior type of guns and projectiles, other things being equal; but, tactically speaking, superiority of gun fire may result from a tactical formation which puts the enemy at a disadvantage as regards his gun fire, and enables a fleet to concentrate its gun fire on certain ships of the enemy, thereby reducing his tactical efficiency by crippling one or more of his ships. The purpose and end and aim of tactical dispositions is, therefore, to present gun fire in its

most effective *position* for the first blow, and then for each successive position which unforseen contingencies may necessitate. This may be stated as a tactical axiom.

Axiom 2. *The object to be sought in fleet tactical dispositions —or formations in relation to that of the enemy—is to enable all ships to deliver an overwhelming concentrated gun fire on a portion of the enemy's formation at the earliest possible moment, and at the same time have him in such a position that he cannot bring his concentrated gun fire to bear on any one portion of your formation on equal terms.*

This tactical disposition is known as the *superior position.* It implies, for one thing, that the fleet so disposed can concentrate at a less average range than the enemy, or that the enemy cannot concentrate on any one portion in return. Concentration of fire is the key to victory, and fleet formations and movements designed to secure this advantageously, and with the least disturbance of continuous aim, are what we must seek. A bad formation, stupidly adhered to at moderate ranges, for a *few moments only,* may, in these day of overwhelming gun fire, alone lose the victory. "At the earliest possible moment" implies the first blow, thereby injuring at once the enemy's initiative and increasing your offensive power in a geometrical ratio as you destroy his. This question of geometrical ratio has been illustrated in numerous tables, but is simply this: Given two hostile squadrons A and B, each of whose gun fire is valued at 100. At the end of a given period say that the damage to A has been 20 and to B 10, then in the next period the value of A's effective gun fire will be 80 and B's 90.

If tactical dispositions can accomplish such results, it behooves us to study formations in their relation to gun fire.

FORMATIONS IN RELATION TO GUN FIRE.

The following considerations are theoretical in that no allowance is made for poorly drilled crews, or for arrangements or installations of guns which interfere with each other when all guns are firing, nor is fire control, nor range finding, nor any practical consideration, for the moment given weight. These matters will be dealt with later on in their proper place.

An examination of the installation of guns on our battleships, built and building, will show us that for each ship's total broad-

side fire as a unit, the corresponding bow and stern fire will be, in percentage, about as follows:

Oregon class and Iowa, 40%; Kentucky, 42%; Alabama, 38%; Maine, 37%; Virginia, 45%; Connecticut, 42%; and the 12-inch, 10-inch proposed installation, 50%. This bow or stern fire is reckoned from right ahead, or right astern, to 45° forward or abaft the beam on either side, but not on both sides at one and the same time (any more than that firing both broadsides at once would mean 100% on each side). This is because the forward and after turrets can only fire on one side or the other at one and the same time. Moreover, while no two persons will agree as to the exact percentage for this bow and stern fire, and, also,

FIG. 1.

while the percentages given are not an index of the value of one ship's fire as compared with that of another, but only to each ship's own broadside fire, yet, for the purpose here used, none of these considerations are important other than that roughly speaking:

1st. Our battleships have an average bow (or stern) fire of about 43% in either bow (or stern) quadrant.

2nd. This percentage is large in spite of the number of smaller guns in broadside, because of the preponderating value of the fire of large calibre guns, where range, accuracy, and penetration are taken into consideration.

3rd. The forward and after turret guns, on the midship line, cannot, for structural reasons, fire more than about 45° abaft or forward of the beam respectively.

Let us apply these considerations to a study of concentrated

gun fire of our battleships in column of vessels. If the line A B C, Figure 1, represents a number of our battleships in column, then any object in the area E D F may receive the concentrated broadside fire of the starboard battery of all the ships in column. The distance B D = ½ A C = ½ the length of the formation. Any object within the arc A C E or C A F will receive less than 100% at a rapidly diminishing ratio as it approaches the line A B C. Similar conditions apply to the port battery.

These considerations may be put in the form of a tactical axiom.

Axiom 3. *In column formation the area of maximum concentrated broadside gun fire for either battery is at right angles to the middle line of the formation at a distance equal to half the length of the formation.*

The ability to concentrate decreases rapidly as it goes astern of the quarter bearing of the leading ship or ahead of the bow bearing of the rear ship. As a corollary of this axiom it will be noted that the closer the unit ships can steam in column the shorter the distance B D. Naturally, therefore, the more that officers are drilled and accustomed to close order manoeuvering the better able ships will be in column formation to concentrate their fire at close range. This will become more evident as we proceed, and it can then be stated as a tactical axiom for all formations.

Let us now take line formation and examine its possibilities in the matter of gun fire. We find, from Figure 2, that in line formation, A B C, the area, F D E, for concentration of bow or stern fire, is not the area of maximum gun fire because the ships on the flanks, A and C, can bring certain guns of their broadside battery to bear just clear of the bows or sterns of their next in line, and that, within a limited arc between E D F and H D′ G, an area presents itself within which the total bow or stern fire of the fleet may be augmented. It is notictable that the greater the distance between ships in line the greater the number of guns which can be brought to bear, *although at increased ranges.* This feature of line formation is important when we consider certain tactical arrangements later on but in general terms we may regard it as a tactical axiom that:

Axiom 4. *In line formation the maximum area of concentrated*

gun fire is almost entirely that of the bow and stern guns, and is on a line normal to the middle of the formation and at a distance a little less than half the length of the formation.

As a corollary it may be stated that the closer the ships are in formation, the shorter the line B D and the longer the line B D'.

Let us now take échelon formation. A B C, Figure 3, with ships heading North, and on a line bearing 45°, *i. e.*, NW.-SE. The ship at A is firing its broadside guns so as to clear the bows of the ship on its starboard quarter, *i. e.*, North of the line A D F. The ship at C is firing its broadside guns to the

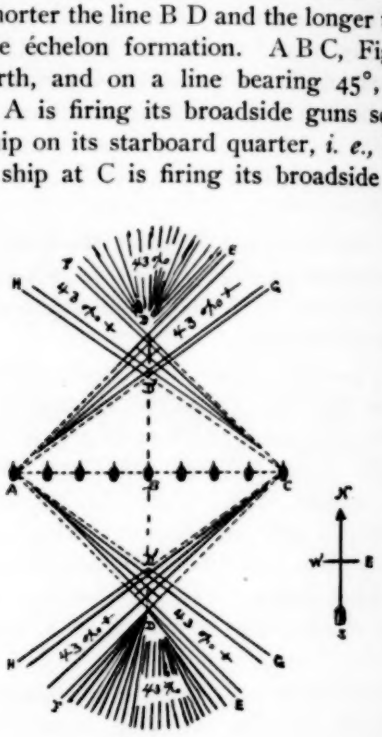

FIG. 2.

Eastward of C D E and the area of maximum concentrated gun fire is E D F, the distance C D being about ½ A C = about ½ of the length of the formation. To the Southward of the line A D F the effective fire of the ships diminishes rapidly, until we reach the line of bearing A B C when only the stern (quarter) fire of the flank ship C is available. This marks the weak point of échelon formation, but the direction of the line of bearing of any formation is its similar weak point. This self evident proposition may be stated as a tactical axiom:

Axiom 5. *In any rectilinear (or line of bearing) formation the maximum concentration of gun fire on any azimuth becomes less and less as the azimuth approaches the line of bearing.*

We have spoken of the formations in Figures 1, 2, and 3 as column, line, and échelon, respectively. These are really unnecessary terms, but we have inherited them and they are convenient. As a matter of fact what is important is the line of bearing of ships in relation to the course which is being steered. In Figure 3, the ships are steering North on a line of bearing NW.-SE., A being the leader. This is échelon, but if the ships all simultaneously change course to NE., the line of bearing remains NW.-SE., but the formation is line. Similarly if the ships simultaneously change course to NW. the line of bearing remains NW.-SE., but the formation is column.

Let us for convenience adopt this method of considering formations by line of bearing and courses and study the effect on gun

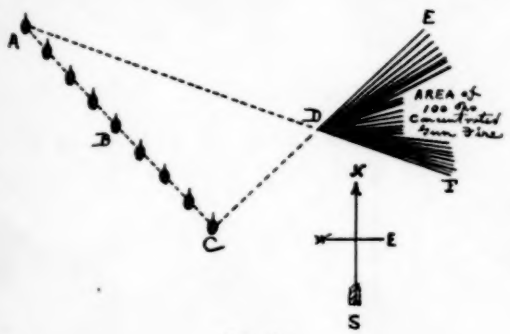

FIG. 3.

fire of changing lines of bearing, say two points ($22\frac{1}{2}°$), the course remaining the same, say North, as in Figure 4. Afterwards we will study the same effect with the line of bearing constant and the course changing through the two points ($22\frac{1}{2}°$). Let us assume that there are nine ships, A being the leader.

Disregarding for the moment A A′, or line formation, as giving only a bow or stern fire (of 43% for our ships), we see that in the formation A B, Course North, line of bearing E S E, the area of maximum broadside concentration is at b (also at b′). Continuing in this way, for A C, line of bearing S E, we have c and c′; for A D, line of bearing SSE., we have d and d′; and for A E, line of bearing South, we have e and é, in all cases the broadside gun fire being 100% *at the closest range possible for total concentration.* If we continue to change the line of bearing by two points, SSW., SW., etc., to West, we will find that the

diagram reverses itself and b', c', d' and e' are starboard battery areas. This will be seen to be a very important point when it comes to applying changes of bearing to tactical problems, and we may note that this is because b', c' and d' change very little in their continguity in a change of line of bearing through four points.

As shown in Figure 4, we may state it as a tactical axiom:

Axiom 6. *With a fixed course, changes in line of bearing in any quadrant (90°) move the areas of maximum concentrated*

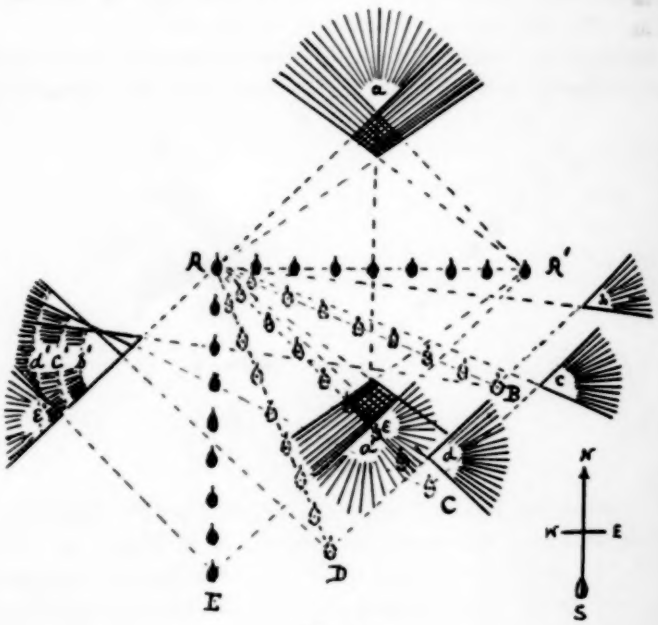

FIG. 4.

broadside fire in the same direction as the changes of bearing, but the location of the areas for said quadrant are not symmetrical on opposite sides of the lines of bearing.

For instance, the movements of the areas *b*, *c*, *d*, *e*, and *e'*, *d'*, *c'*, *b'*, are in each case to the right corresponding to the changes of bearing, but *b*, *c*, and *d*, and *d'*, *c'*, *b'*, are not symmetrical as regards, say, the line A E.

Passing now to Figure 5, let us consider a formation on a fixed line of bearing, say East and West, and with a series of simultaneous changes of course of two points to the right.

These changes of course, from North to East, are shown by the radial lines of azimuth A, B, C, D, and E, and for further illustration are carried past East to ESE. at F; SE. at G; and SSE. at H. The areas of maximum concentration of gun fire corresponding to each heading are designated by the same letter, viz., A by *a*, B by *b*, etc.

Figure 5 shows that the areas of concentrated gun fire are symmetrically disposed in quadrants on each side of the line of bearing, and that these areas move to the right or left as the ships

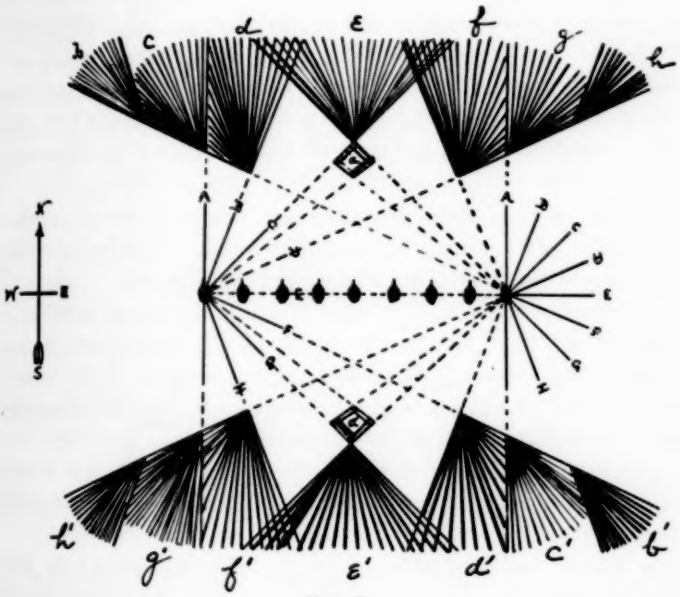

FIG. 5.

turn their heads simultaneously in azimuth to the right or left. This may be expressed in the tactical axiom:

Axiom 7. *In a rectilinear formation on any fixed line of bearing the areas of maximum concentrated broadside gun fire are disposed symmetrically in quadrants on each side of the line of bearing corresponding exactly to changes of course through a similar quadrant, and these areas follow the motion of the ships in azimuth, moving to the right or left as the ships change their course to the right or left.*

From a study of Figures 1 to 5, inclusive, we may also state it as a tactical axiom:

Axiom 8. *In any formation the less the distance from centre to centre of ships the less the distance of the area of maximum broadside concentration of gun fire for that formation.*

As previously stated the distance between ships in formation at which it is safe to manœuvre depends upon the skill of the officers handling them.

Before proceeding further, it will be noted that in speaking of the "areas of maximum concentration of gun fire" we have in all cases considered the *minimum distance* at which such *maximum concentration* can be obtained in a given formation. In actual battle at long ranges the corresponding areas widen out enormously. For instance, in Figure 4, the broadest area *e* extended includes also *d*, *c* and *b*, and the area *b'* extended includes also *c'*, *d'*, and *e'*. Also in Figure 5, *d* includes *c* and *b* and part of *e*; *f* includes *g* and *h* and part of *e*, etc. This is so important that it is well to put it in the form of a tactical axiom:

Axiom 9. *As the areas of maximum concentration of gun fire for rectilinear formations are fan-shaped they overlap more or less at ranges much beyond the minimum distances.*

Also it may be noted that in discussing formations in relation to gun fire, it has been shown that in all simple rectilinear, or line of bearing, formations, it is possible to concentrate all the broadside on a target at some point or other beyond a certain minimum distance, *excepting in line formation*, when bow and stern fire only are available. As before stated bow and stern fire merge into broadside fire at 45 on the bow or quarter, and in our ships are only 43% of the value of broadside fire.

Thus far we have considered the mutual relations of the line of bearing and the course. In Figure 4, the line of bearing is the variable, and in Figure 5, the course is the variable. A closer inspection will show that in Figure 4, for instance, the areas *b* and *b'* bear the same relation to the two-point line of bearing formation A B that the two-point course formation bears in Figures 5, in which *b*, *b'*, *h*, and *h'* represent the corresponding areas of gun fire. In the same way in Figure 4, the formation A C and corresponding areas *c* and *c'* represent exactly the similar areas *c*, *c'*, *g*, *g'* in Figure 5, both being four point variations. Similarly in Figure 4, the formation A D and corresponding areas *d* and *d'* are exactly the same as the areas *d*, *d'*, *f* and *f'* in the similar six point formation in Figure 5.

We may therefore deduce the following important tactical axiom:

Axiom 10. *If, in changing a line of bearing a certain number of points to the right or left, we also change the course, or azimuth of the ships heads, the same number of points to the left or right, the area of maximum concentrated broadside gun fire will not be changed in its relation to the resulting formation.*

This axiom gives the key to the relation between the line of bearing and the course in simple rectilinear (or line of bearing) formations. We will now consider other than simple rectilinear formations.

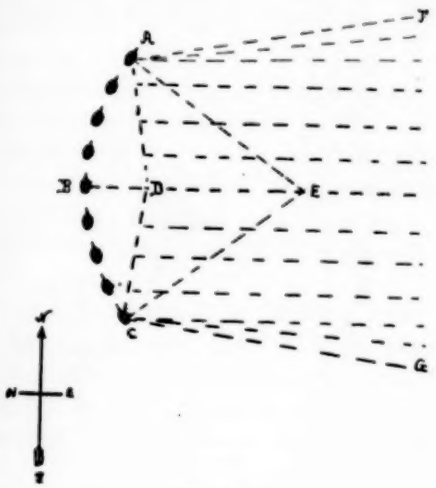

FIG. 6.

In Figure 6 we have disposed nine ships as if steaming on the arc of a circle whose centre is at E. The nearest point at which we may secure the maximum concentrated broadside fire of all the ships is at D, which is at a point abreast the middle ship and at a distance, B D, less than half the radius B E. This is for the concave side of the formation. On the convex side it is not possible to obtain, at any point, a concentrated fire. To illustrate the limited value of the curved formation, in Figure 7 the ships in Figure 6 are assumed to have all simultaneously changed course to North. It is not possible to concentrate the broadside on the convex side, and on the concave side the conditions are as if A B C were a column of vessels A D C and D E′ = ½ the distance A C. Similarly if in Figure

7 all the vessels simultaneously change course to, say West, the concentrated bow and stern fire would be the same as that of a line formation = A D C. In other words, it is a disadvantageous formation, except, as in Figure 6, on the concave side, where the ships are steaming along the arc of a circle, and in that case the area of maximum concentration is as shown at D.

What has been said as to the circle applies with equal force to a double échelon formation as to the value of its concentrated fire. It is merely that of a smaller simple rectilinear formation A D C, as in Figure 7. According to Axiom 5 it has the further disadvantage that the ships are on two lines of bearings with two weak points. In Figure 6, with ships steaming on the arc

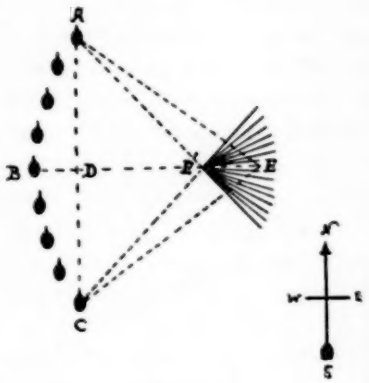

FIG. 7.

of a circle, we have the formation which fleets assume, at times, when one has a marked advantage over the other in speed. The slower fleet endeavors to partially offset the disadvantage in speed by turning in a circle of somewhat shorter radius than that which the faster fleet is obliged to assume in order to parallel it. The advantage in concentrated gun fire rests with the faster fleet because its formation is concave towards the slower fleet whose formation is correspondingly convex. The latter cannot concentrate its gun fire and the former can. Superior speed has both a strategic and a technical advantage. The slower fleet must accept battle on terms dictated by the faster fleet, and the faster fleet can assume formations which give an advantage over the slower. We will see this clearly as the discussion progresses, but it is just as well to state it in a tactical axiom.

Axiom 11. *Superior speed is tactically of the greatest value in enabling a fleet to quickly assume a superior position.*

It may be stated as a corollary that large reserve speed may answer the same purpose. For instance, with a fleet able to steam 16 knots, it may manoeuvre at 10 knots or 12 knots and use its reserve speed to assume quickly the superior position when a chance offers. On the other hand the enemy may use reserve speed to make a counter move. It must ever be kept in mind, however, that battles may be decided by an initial advantage, as suggested in Axiom 2.

The superior position in general is made up of many elements:

1st. The sunlight *on* the enemy's ships and in his eyes for firing at your ships.

2d. The sea rough and the enemy rolling and exposing vulnerable parts above and below the armor belt.

3d. More effective concentrated gun fire can be delivered at less average range than the enemy can possibly return on anything like equal terms.

4th. A certain distance or range may be advantageous for special reasons.

5th. The wind may be strong or blowing towards the enemy, interfering somewhat with the rapidity of this fire.

6th. In the next move you may be sure to get the advantage.

7th. Having the enemy where he can only make a certain move, or failing to take it, he must fight with the odds against him.

If all that has so far been said on the relation of formations to gun fire, as stated in the tactical axioms, and illustrated in Figures 1 to 7, is not clear, it is because the language used is obscure, but at least the gun fire diagrams are clear, and speak for themselves. They must be the basis of naval tactics, for there can be no other. It is in the practical application of these diagrams and tactical axioms that we have the elements of fleet tactics.

TACTICAL METHODS.

We have discussed the gun fire diagrams. The question is how to go from one formation into another by a method which shall least disturb gun fire in the process, or by a method which shall favor concentration of gun fire *as far as possible* during or on the completion of the manoeuvre. This should be simple

enough but it is at this point that experts disagree, and people begin to stumble. This is because our tactical signal books are merely a jumble of diagrams of tactical manoeuvres which have no relation to gun fire, with no hint as to the why or wherefore of any formation. The result is that we accept fleet tactical drills as a necessary evil without realizing that there are important problems to be solved which are as vital and as pressing as those which brought about the recent revolution in our target practice methods.

The fact is briefly that there are many methods of going from one formation into another. One method may be splendid under one set of conditions and fatal under another, just as in deployments in military tactics in actual battle. Everything depends upon the bearing and formation of the enemy as to what relation our formation should bear to his. A false move may give the deciding advantage to an opponent. The chances of victory are with the side which makes the fewest mistakes. Only an expert who thoroughly understands naval tactics in relation to gun fire can handle a fleet to its full advantage. There is no throwing dice. It is a game of skill requiring all the training and science of polo, or base-ball, or foot-ball. There is no special virtue *per se* in rectangular methods, or direct methods, or in column, or in échelon, or in fancy group formations, or in any formation in particular. The choice of method lies in the relation, *at the moment,* of your gun fire to the bearing and formation of the enemy as affecting his gun fire. This we will consider later, because one must first take up the question of tactical methods in general, then compare the different methods *under exactly similar conditions,* and, finally, in a few tactical problems apply them as we probably would in action. Only by the comparative method can we grasp what eludes so many.

There are three classes of tactical methods which we shall consider (1) The Rectangular (or Angular), (2) the Direct (really Oblique) and (3) Special Methods.

By the Rectangular Method a fleet goes from one formation into another by a series of simultaneous and successive movements in which each ship performs the same evolution at undiminished speed, and in which the course and distance passed over are ultimately the same for each vessel, or to state it tersely: Each ship executes, either simultaneously or successively, iden-

tically the *same* manoeuvre, at the *same* speed, and with the *same* effective helm.

By the Direct Method the guide or leader slows after the movement is begun (or other vessels use reserve speed) and the obliquing ships change course a certain number of points, reaching their new positions by prescribed rules as to variations in helm and speed. Much depends on the speed of the guide as to how much time and sea room the direct (oblique) movement occupies. Usually the oblique does not exceed three points.

By Special Methods the aim is to reach the new formation quickly. In the main the special methods are compromises between the rectangular and direct methods, but each must be studied in relation to all others as regards the object to be sought before one can use any method intelligently.

The formations here considered are line, column and échelon, *i. e.*, either four or eight point variations of lines of bearing. Two point variations are merely intermediate forms of these three and are not here illustrated. In comparing the three tactical methods, it will be simpler to consider that reserve speed is *not* used because if it is used in one case it may be used in the others to hasten their performance. Assuming therefore that standard *fast* speed (and not *full* speed) is used, we will in each case apply certain tests to the different methods of changing formation by way of comparing them. These tests are (1) time consumed, (2) least interruption of concentrated gun fire, (3) non-interference of ships with each other in gun fire, (4) variations in range during the manoeuvre, and (5) change in range on its completion. As previously stated, the bearing and formation of the enemy is the determining factor in selecting any particular method in a given case. There are, of course, times when the proximity of land or lack of sea room will admit of only one certain method being used, but we will consider only the general proposition with plenty of sea room.

Assuming that there are nine ships steaming at standard fast speed of 12 knots, and that the maximum distance from center to center of ships is 250 yards, any formation would be one nautical mile (6,000 feet or 2,000 yards) in length, and the formation would *advance* one mile in five minutes. In obliquing the *advance* would correspond to difference of latitude in plane sailing, and *lateral transfer* to difference in longitude or depart-

ure. Thus in every manoeuvre we must consider both the *advance* and *lateral transfer* in their relation to the bearing and distance of the enemy. It will be noted in all diagrams that A is the leader or a flank ship, B is the flagship (always the centre ship), and C is the other flank ship, or in column the rear ship. The diagrams are not drawn to scale and do not represent the actual turning powers of ships in relation to the dimensions of the drawings. They are merely intended to be suggestive and comparative, and must not be taken too seriously. They illustrate, however, the only means by which we may intelligently judge the methods to be used.

1st. *To go from line into column, or column into line, at right angles to the original formation.*

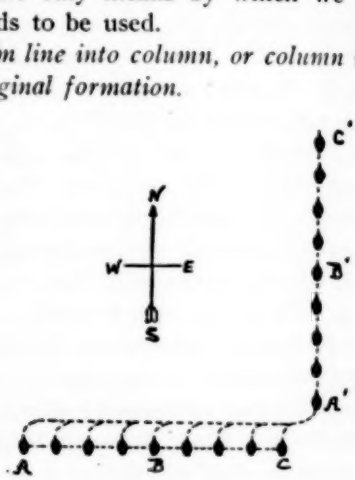

FIG. 8.

(a) By the rectangular method ships go from line into column or column into line by all vessels going eight points simultaneously to the right or left. In this case, to change into formation at right angles, involves head of column going eight points to the right, or left, and all ships following successively. The entire evolution takes, for nine ships, about six minutes, and the rear ship will be about 400 yards from the point at which the evolution began. In either case of line into column or column into line the flank or leading ship will be one nautical mile from where the evolution began. This is shown in Fig. 8, which illustrates the rectangular method of going from line into column. C advances one mile and A is transferred laterally one mile. By the direct method, Figure 9, we will first consider going from line into column. The flank or guide ship C slows

to ¾ speed (in this case 9 knots) because the other ships have to cover distance in the ratio of about 7 to 5 on account of obliquing. Each ship, as it comes into column astern of C, slows to ¾ speed, and, just as the column is formed, signal is made and all ships go ahead at full speed. A or A′ will be much beyond D, by the time full speed is regained. The time occupied in the manoeuvre to regaining full speed will be about ten minutes, and the distance of the rear ship about one mile from where the evolution began. A (or A′) would be laterally one mile to the right (or left). As compared with the rectangular method the direct movement is more difficult, and during the movement the formation is disorganized, thus giving the enemy an opportunity

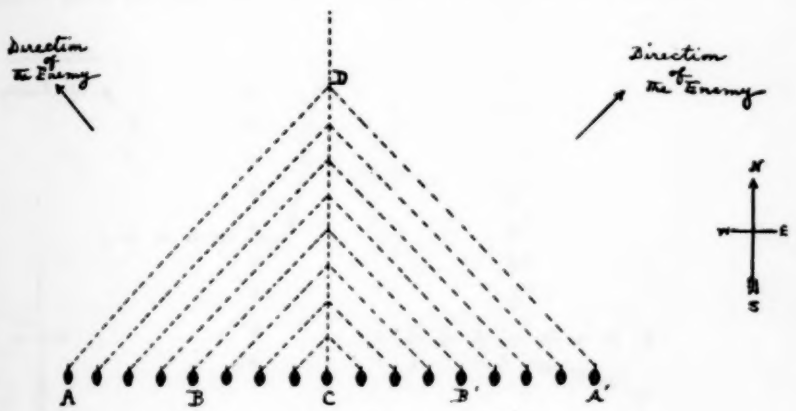

FIG. 9.

to make a quick counter move. For all that, as in Figure 9, the enemy being in the direction of the left hand arrow for A B C, or of the right hand arrow for A′ B′ C′, the direct method has the advantage over the rectangular in gun fire and range during the movement, but the guide has had to slow to ¾ speed, and loses the lead over the direct method, four-tenths of a mile in this particular case.

In going from column into line by the direct method there are several things to consider. If the guide slows to steerage way and allows the rear ships to oblique and make up distance quickly it will take about eight minutes to form line. If the guide continues on at half speed it will take about twenty-five, and this does not include the time necessary to resume standard speed.

We will therefore drop out of consideration the direct method of going from column into line as a waste of time.

By the "Special Method," shown in Figure 10, ships may go from line into column, without loss of speed, without loss of distance literally, and with gun fire available during a large part of the movement. The flagship B will also still retain its central position. When the signal of execution is made, A B C being in line heading North, all ships put their helms to starboard, as if to go into column, but the right division of four ships after going through eight points left, executes head of division eight points right, and stands on heading North, the other three ships following in succession. The leading division of five ships circle, each ship from B to A using less and less helm in order to turn

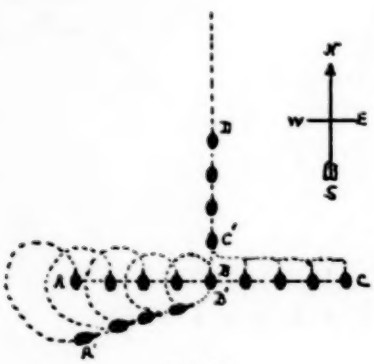

FIG. 10.

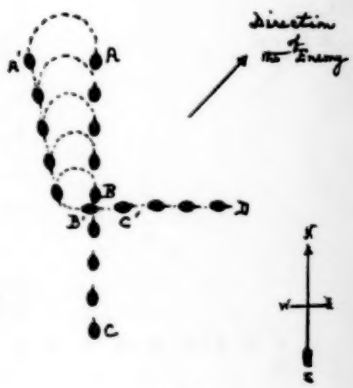

FIG. 11.

in larger circles. B, the flagship, turns in as small a circle as possible to B′, and follows in astern of C′ (which is the new position of C). It will be found that the wing A B, without reducing speed, will arrive in position to form column coming up astern of C′, as shown in Figure 10, at A′ B′, without loss of distance. This movement will occupy six minutes, or exactly the same time as the rectangular method, and has many advantages over it. It has the advantage over the direct method in that there is no slowing. It has the advantage over both methods in that it confuses the enemy as to your real intentions.

To go from column into line by the "Special Method," shown in Figure 11, the rear division of the column goes head of division eight points to right. The five ships of the leading

division circle, as shown in Figure 10, and come in astern of C'. When all the ships are in column, they execute eight points left simultaneously and come into line heading North. The movement might have been executed by the head of rear division going to the left and the leading division circling to the right.

The advantage of the "Special Method" over the rectangular in special cases may be illustrated in Figure 11 with the enemy

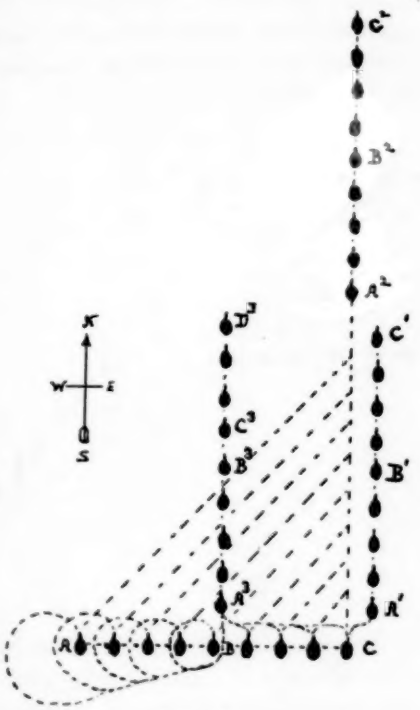

FIG. 12.

in the NE. quadrant. If A B C should perform the change of formation by going head of column eight points right, the rear ships would soon have to cease firing because A would be between them and the enemy. The more the special methods are studied the greater the average advantages will become apparent. To illustrate all the available methods comparatively they are grouped in Figures 12 and 13. In Figure 12 the rectangular, direct and "Special Method" are compared side by side *at the completion* of the evolution of going from line into col-

umn. The rectangular and "Special Method" are on equal terms as regards advance, but the "Special Method" does not change the *average* distance laterally. By the direct method the *advance* is more than twice as much, and the *lateral transfer* practically the same as for the rectangular method. All things considered, the "Special Method" is best for average conditions. (It will be noted that the flagship B always retains its central position.)

In Figure 13, the direct method of going from column into line is not considered as it is practically useless. The question as between the rectangular and the "Special Method" is re-

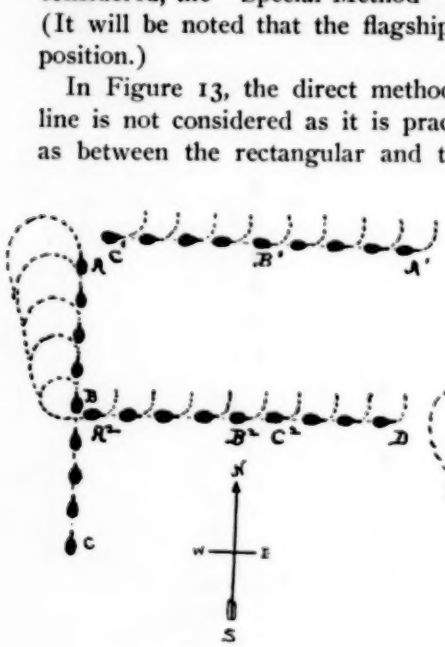

FIG. 13.

FIG. 14.

ferred to in the discussion of Figure 11. The *lateral transfer* is the same, but the *advance* is one-half mile greater for the rectangular than for the "Special Method." This latter may be the important and deciding feature in choosing between the two methods.

The advantage of the special methods will be apparent also when we consider the evolutions of going from (1) column into column at right angles, or (2) from line into line at right angles, or (3) échelon into échelon at right angles. This last, échelon into échelon at right angles, is illustrated in Figure 14 as typical of all three movements.

In Figure 14, A B C is in échelon NW.-SE., heading North. By the "Special Method" at the signal of execution the four

rear ships execute ships four points left and the head of division eight points right. The five leading ships circle to the left, as heretofore explained, and come into column astern of C′ (the new position of C). When all are in column the course is changed by signal to North.

By the rectangular method, Figure 15, A B C goes ships four points left and then head of column eight points right. When all are in column heading NE., signal is executed ships four points left. There is no adequate direct method of going from échelon into échelon at right angles, but for line into line at

FIG. 15.

FIG. 19.

right angles, or column into column at right angles, the direct method might under certain circumstances prove very valuable. As between the rectangular and "Special Method," shown in Figures 15 and 14 respectively, there is a difference of about ½ mile (1,000 yards) in *advance*, and this may prove the deciding point in choosing between them. By the "Special Method" there is less change of average range and better average gun fire during the movement.

It is manifestly impossible to lay down any rules for eight points change of line of bearing as to what method to use without considering, in each case, the position and formation of the

enemy. Given this, and also the *purpose* of a change of line of bearing, the method to be used will be clear at a glance.

We will now consider four point changes of line of bearing.

2d. *To go from column into échelon, or échelon into column, changing line of bearing four points.*

Four methods are here given of performing this evolution. They are illustrated separately in Figures 16, 17, 18 and 19, and together graphically in Figure 20.

In Figure 19 the direct method is illustrated, and when the evolution of going from column into échelon is completed, and

FIG. 16.

FIG. 17.

full speed resumed, the guide, A, has advanced considerably over one mile, and the *lateral transfer* of the rear ship has been 4,350 feet (1,450 yards) *to the left.* By the rectangular method in Figure 16, A has *advanced* to A', a distance of about 4,500 feet (1,500 yards), while the lateral transfer has been about the same amount *to the right.* In Figure 17, by the "Special Method" the lateral transfer of the flank ship has been about 4,500 feet, but the advance of the leading ship is less by some 3,000 feet (1,000 yards) than in Figure 16, or, in other words about 1,500 feet (500 yards). By the special method shown in Figure 18, called the "Pin Wheel," at the signal of execution B slows to half speed, the rear division of four ships

uses the direct method and obliques into position, slowing to half speed before coming on the line of bearing, while, at the same time, the leading division of four ships put helms to port, sheer over into position, then slowly take up half speed as B arrives on the line of bearing. In the resulting échelon formation, A′ B′ C′, Figure 18, A has both *advanced* and *transferred laterally* about half the distance as by the "Special Method" of Figure 17.

The four methods are graphically compared in Figure 20,

FIG. 18.

FIG. 20.

by which it will be seen that the direct method gives lateral transfer to the left; the rectangular and "Special Method" to the right, and the "Pin Wheel" is a compromise of all the other three. The great drawbacks to the "Pin Wheel" are difficulty and danger in execution, and having to slow to half speed.

To go from échelon into column by the rectangular method, by the direct, by the "Special Method," and by the "Pin Wheel" method are all four illustrated in Figure 21, showing the relative positions of the column on the completion of each manoeuvre.

A B C, Figure 21, is the original formation in échelon. A′ B′ C′

is column by the direct method; $A^2 B^2 C^2$ by the rectangular method; $A^3 B^3 C^3$ by the "Special Method," and $A^4 B^4 C^4$ by the "Pin Wheel" method. The choice of methods depends, as always, upon (1) the position and formation of the enemy, and (2) upon the object sought by A B C. In the direct method we

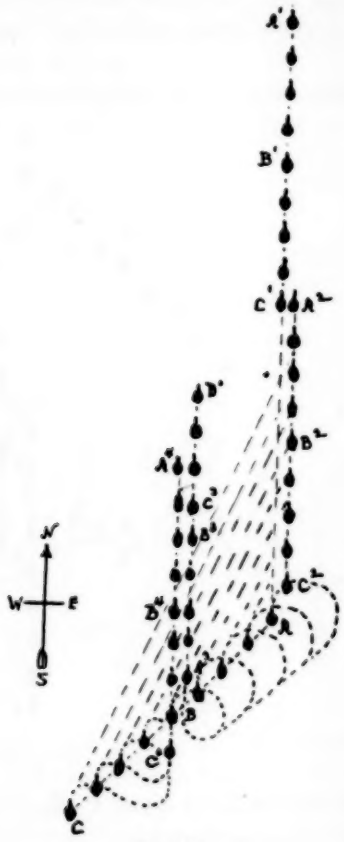

FIG. 21.

have the extreme of combined *advance* and *lateral transfer*, and in the "Pin Wheel" the least. The "Special Method" offers the best average conditions.

3d. To go from line into échelon is illustrated in Figure 22, in which A B C represents the fleet in line, and A' B' C' the fleet in échelon NE.-SW., heading North by the direct method, in which the guide slows to half speed. $A^2 B^2 C^2$ represents

the corresponding position by the rectangular method. $A^3\ B^3\ C^3\ D$ shows the same by the "Sjecial Method." $A^4\ B^4\ C^4$ shows the same by the "Pin Wheel" method, in which the guide, B, slows to half speed, the four ships of the left division slow to steerage way, closing in with port helm, and resuming half speed as B comes on the line of bearing. The ships in the right wing proceed at standard fast speed, and oblique to the left slightly, slowing to half speed as they successively come on the line of bearing. When all are on line of bearing NE.-SW.,

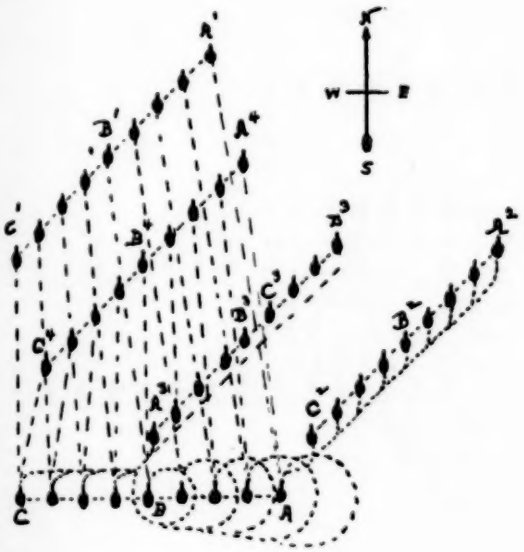

FIG. 22.

standard fast speed is resumed. The "Special Method," as shown in $A^3\ B^3\ C^3\ D$, satisfies best the average conditions.

In going from échelon into line, as shown in Figure 23, four methods are compared graphically. A B C is the original échelon formation. $A'\ B'\ C'$ is line by the direct method, in which the guide, A, slows to half speed. $A^2\ B^2\ C^2$ is line by the rectangular method. $A^3\ B^3\ C^3\ D$ is line by the "Special Method," and $A^4\ B^4\ C^4$ is line by the "Pin Wheel" method.

It is only by studying the methods comparatively and considering the object sought that one can decide intelligently upon which one to use.

Figures 4 and 5 as gun fire diagrams, and Figures 12, 13, 20, 21, 22, 23, and 25 are in themselves a small compendium of fleet tactics, worthy of many months of careful study.

Most flag officers prefer rectangular methods owing to the smaller margin for misunderstandings, the continual maintenance of standard speed, and the general "follow the leader" character of the movements, but there are times when other methods are imperative. Under average conditions the "Special Method" has all the advantages of the rectangular, but it is not the purpose

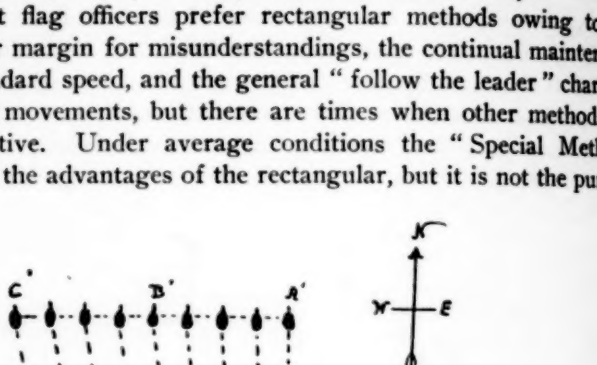

FIG. 23.

to here advocate anything except the study of fleet tactics on the broadest and soundest lines. Only practical fleet exercises can really test the different methods as here illustrated, but, after all, it is in the practical application of theories that we make progress of any kind.

TACTICAL PROBLEMS.

So far we have considered formations in their relation to gun fire, and have noted the different methods available for going from one formation into another. We will now consider the practical application of the gun fire diagrams and various formations to certain theoretical problems. The difficulty is that we

must consider every possible movement and formation it is in the power of the enemy's fleet to take either offensively or defensively; for it is much like a game of checkers in which certain moves on one side compel the opponent to sacrifice two checker men for one. We must quickly grasp the advantages and disadvantages of every tactical disposition, as well as the possibilities of the *next* move. The instant there is an opening, or a weak point, advantage must be taken, and taken quickly. We must therefore use that method of going from one formation into another which will give the required *advance* or *lateral transfer,* and use that line of bearing and heading which will deliver gun fire most effectively.

To accustom officers to judge these things drills should be instituted, at first with steam launches of a fleet, or even with pulling boats. The only fittings needed are boat compasses, and sighting vanes at 45° forward and abaft the beam. At first, umpires will decide on the relative values of concentrated fire at the end of each move. Later on, simulating somewhat actual battle conditions, it will be recognized that, during the time ships are manoeuvering for a change of formation, gun fire will be disturbed. Mistakes in moves will be expensive. Expertness in handling boats, and afterwards ships, will count for much. Familiarity with moves and counter moves will suggest what signal will come next, and, in the case of the failure of one or more ships or boats to read signals, intelligent action can be taken from seeing other boats or ships change course or manoeuvre. Officers pitted against each other in steam launch or pulling boat flotillas should become familiar with the principles, so that in subsequent tactical exercises with battleships in drills at sea, they could gain familiarity with the true tactics of the guns as actually mounted in ships. A few ships should always be detailed to represent the enemy's skeleton formation, so that, given an advantage, every captain will recognize it on sight, or, if at a disadvantage, we will know how to make the counter move and retrieve the situation. Any other tactical drill is illusive, barren, and lifeless, except in so far as it teaches officers to handle ships in close proximity to each other.

To illustrate the question of judgment, let us consider the following problem:

Problem 1. Two equal hostile squadrons in parallel columns

within range of concentrated broadside gun fire, one squadron being somewhat in the lead of the other, as shown in Figure 24, which has the superior position?

From a casual glance at Figure 24, we might say that neither column has a decided advantage, since A B C can concentrate on the leading vessels of D E F, which can, in return, concentrate on the rear vessels of A B C.

As a matter of fact A B C has the *superior position*, but is in a wrong *formation*.

To show this let us assume that the leading ship, A, in the

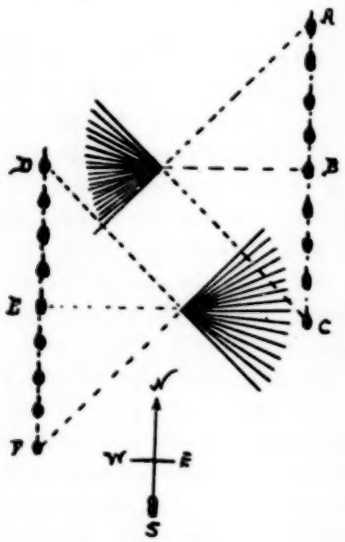

FIG. 24.

new formation, A B C, in Figure 25, is in exactly the same relative position from D as in Figure 24, but, instead of being in column heading North, is on line of bearing NW.-SE. with all of his ships steering NNW. Let us further assume that it is calm, the sea smooth, and the sunlight not a factor. In the formations, as shown in Figure 25, A B C has the following advantages over D E F:

1st. A B C concentrates all of his broadside fire on the leading ships in the column D E F *at much closer average range* than D E F can in return concentrate on any point of his formation.

2d. By steering NNW., A B C gradually closes with the enemy,

using his superior gun fire to great effect, and, while he loses some of the leading position by steering a converging course, he can at any time change course back to North. This change of course to North will, by Axiom 9, bring the area of concentrated fire to as favorable a position as before (see Figure 5), and at equal speed, A B C will, in échelon, retain the advantage until such time as D E F makes a counter move.

3d. A B C, by steering NNW., soon reaches a superior torpedo position, in which his torpedoes are fired at *an enemy steaming to meet them*, and in a formation in which the openings between

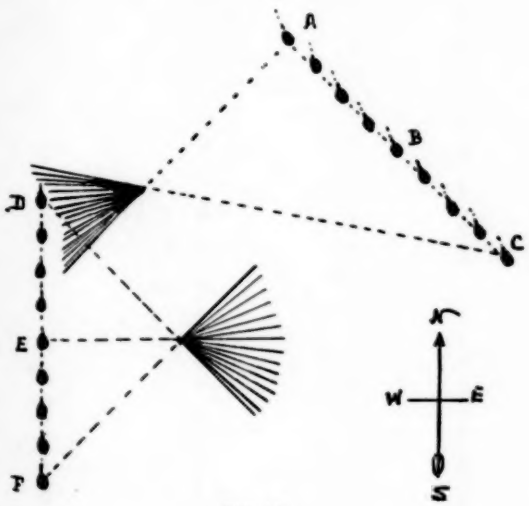

FIG. 25.

ships (or chances of missing) are small, being presented at an oblique angle.

All this answers the question indirectly, for it shows that, in parallel columns, the leading position is valuable in that it has possibilities if properly utilized. With superior speed on the part of A B C, it shows that his object should be to get into an échelon formation as in Figure 25. Let us assume, however, that the speed of the two fleets is the same, and, returning to Fig. 24, with the hostile fleets as there shown, let us put it in the form of a tactical problem:

Problem 2. Two equal hostile squadrons, in parallel columns, at equal speed, within the range of concentrated broadside fire,

the one squadron being somewhat in the lead of the other, as shown in Figure 24, how can the leading squadron best manoeuvre to change line of bearing two points or in this case to NNW.-SSE.?

We have taken a two point change, because, if A B C should

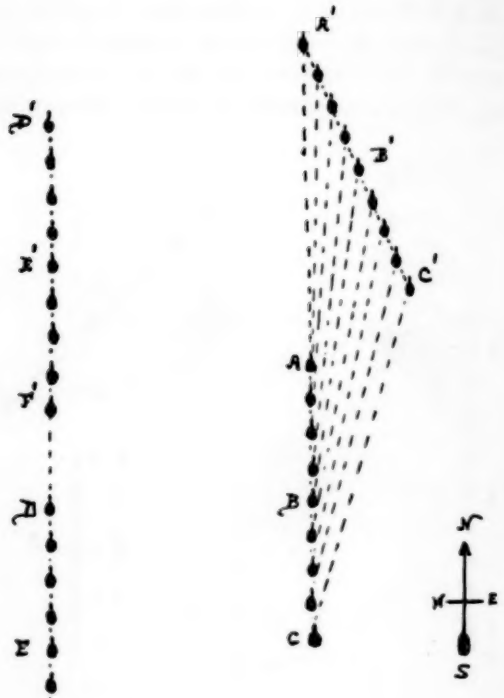

FIG. 26.

manoeuvre for a four point change, *i. e.*, to go into échelon on the line of bearing NW.-SE., as shown in Figure 25, D E F would gain on A, and, by the time the manoeuvre was completed, D would probably be abreast of A. For a two point change we will first consider the direct method, Figure 26, with regard to two important features (1) the gun fire of A B C during the manoeuvre, and (2) the loss of lead due to the

change of formation. A slows to ¾ speed, and the other ships oblique simultaneously to the right. While A B C is thus reaching A′ B′ C′, D E F advances to D′ E′ F′. A is not so far in advance of D′ as A was of D, on account of the loss of distance by obliquing and by A slowing to ¾ speed, but, during the process of obliquing, all the ships of A B C can bring their port broadsides to bear on the leading ships of D E F. The drawback

FIG. 27.

FIG. 28.

to the direct method is that, if D E F makes a counter move, A B C must signal during the manoeuvre and reform his column, before he can do anything else.

In Figure 27 the "Pin Wheel" method is illustrated. B slows to half speed. The rear division obliques to the right and the leading division to the left. By this method time is saved, but the loss of distance or lead is no greater than by the direct method because of the less time at half speed.

By the rectangular method, in Figure 28, head of column A B C changes course to NNW. and, after the last ship has gone into column heading NNW., all the ships change course simultaneously to North, as shown in A′ B′ C′. During this movement the ships of A B C are in a concave formation as regards D E F somewhat like that shown in Figure 6, which is favorable to gun fire. The loss of lead is only that due to obliquing two points, as by this method all ships maintain standard full speed.

Of the three methods illustrated, the rectangular is the soundest and safest, because it does not involve change of speed, it does not lose distance, and at no time is the formation disorganized.

It is well to here again emphasize the fact that, with superior speed, A B C may assume the échelon formation of Figure 25 from column, as in Figure 24, without losing the lead over D. Figure 25 merely shows one phase of Figure 4. If A bore NW. of D and were in échelon on the line of bearing NE.-SW. with ships heading NNE.; or if D E F were heading South and A bore either SE. or SW. of D and were in échelon formation, in the former case NE.-SW. and heading SSW., or, in the latter, in échelon NW.-SE. and heading SSE., we would have all the elements of the superior position in all four quadrants as commonly understood. It is merely that in every case the line of bearing of A B C in échelon shall be about 45° with the course being steered by the column D E F. When this condition obtains, unless D E F at once gets out of the position of disadvantage, he will be defeated, because a few of his leading ships are sustaining the brunt of A B C's concentrated gunfire and cannot concentrate on A B C's ships except at much greater range. Besides having the superior torpedo position, A B C is using the broadside battery which, in Figure 4, is shown to be favorable to concentrated gun fire, and D E F is using the corresponding unfavorable one.

This general tactical proposition in which from a *leading* two point, four point, or six point formation, as A D, A C, and A B, Figure 4, the enemy is held in the superior quadrant of concentrated gun fire, may be called the "lock."

Problem 3. Given a column of vessels in the inferior position D E F, as shown in Figure 25, how can it get out to the best advantage?

In other words, how can it break the "lock." To simplify the problem let us assume that speeds are equal, the sea smooth, and that neither squadron has any auxiliary vessels to protect, both squadrons being free to move at will.

It might seem that D E F could best get out of the inferior position, in Figure 25, by reversing his course and heading South, with a view of taking some other formation more favorable to gun fire, but A B C would make this an expensive move, as in Figure 29, by going into column heading NW., and then changing course first to West and then to South forming line,

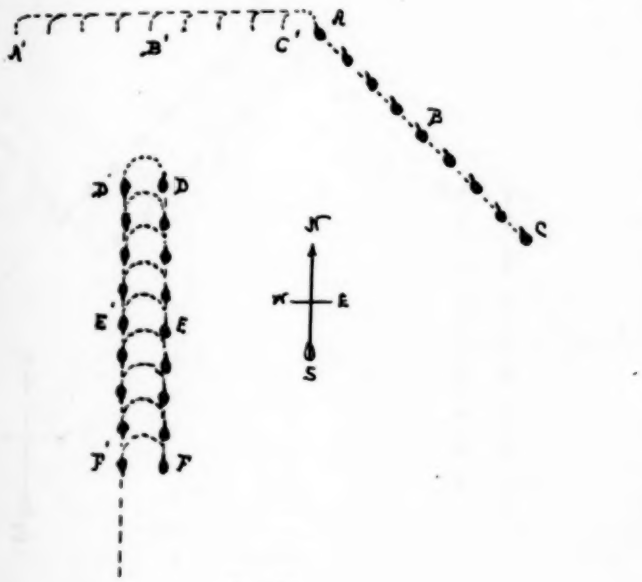

FIG. 29.

and thus "capping" or "T-ing" the rear of the column F' E' D'. Every one recognizes the value of "capping" as a tactical manœuvre, and, for the sake of illustration, we will assume that, when D E F changes course to South, he immediately goes head of column East, Figure 30, while A B C goes into column heading SE. The head of D E F's column will receive the concentrated broadside fire of A B C, and will be forced to alter course to the southward. If D E F on the other hand changes head of column to West, instead of East, A B C can remain in line of bearing formation NW.-SE., and by heading SW., "cap" the rear of D E F's column.

In Figure 31 is given the only method available for D E F, in Figure 25, to break the "lock." It consists merely in D E F's going head of column NW. to parallel the line of bearing of A B C. During the process D E F has the convex formation and cannot concentrate on any part of A B C's formation. A B C changes course simultaneously to NW. A will be abreast of D, and will therefore have lost the leading position, as A' B' C' and D' E' F' will be in parallel columns on equal terms as regards *position*. However, during the time D E F is changing to D' E' F', A B C will have had a great superiority

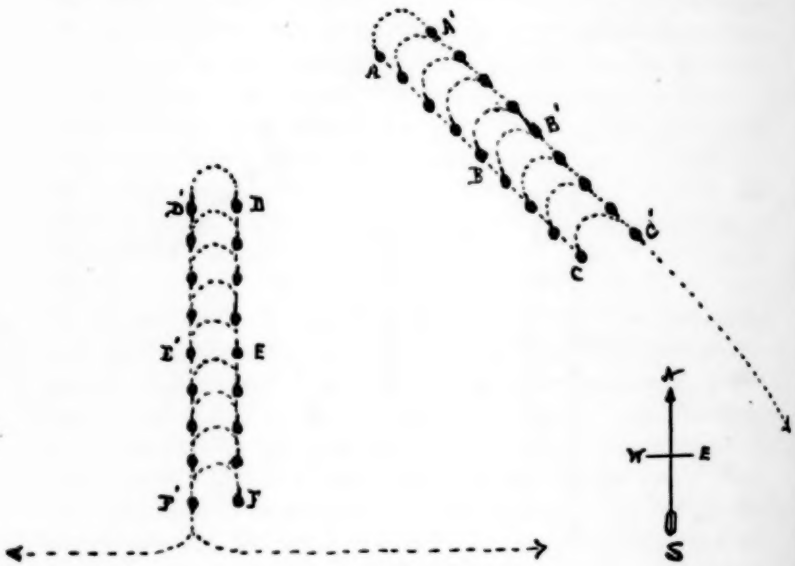

FIG. 30.

over D E F in broadside gun fire, but had D E F remained as he was he would have been defeated. D E F *must* break the "lock," and, to do so, must pay the necessary penalty of the inferior position. If A B C has superior speed, he can use it to gain the lead and again manoeuvre to change bearing two or four points. This will again force D E F to change head of column to the left, and in doing so he will again suffer for being in the inferior position.

Figures 29 and 30 illustrate the inferior position in the "lock," and the danger to D E F of getting "capped" in trying to get out.

The method of Figure 31 illustrates very well the tactics of a squadron with inferior speed (D E F) which has to change course to neutralize somewhat the superior speed of the other squadron (A B C) by making him steam on the arc of a circle with much greater radius than that of D E F. As a matter of fact D E F has no other choice. A B C with superior speed can force him to keep changing course in this manner. Moreover, A B C has

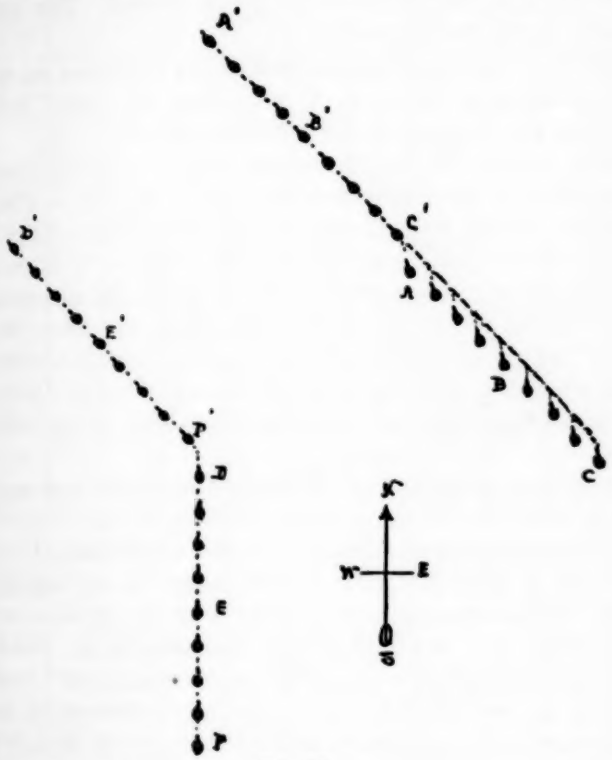

FIG. 31.

the advantageous concave formation as opposed to D E F's convex.

Figures 29, 30 and 31 illustrate clearly:

1st. The advantage of superior speed.

2d. The advantage of the "lock."

3d. How the "lock" has the further advantage that in case the enemy makes a false move in trying to get out, he merely exchanges the "cap" for the "lock."

We must clearly realize that the advantages which come from the superior position are those due to superior tactics. Other things being equal this will decide the engagement because of the advantage accruing in a geometrical ratio to superior gun fire. As soon as one squadron gets a superior position the other can get out of the inferior position only by paying the costs during the process. To remain in the inferior position is fatal. To get out is merely a choice of the lesser evil. This may be illustrated by a tactical problem:

Problem 4. Given a column D′ E′ F′, as in Figure 29, with a hostile squadron in line as in A′ B′ C′, using the "cap," how can the former best get out of the inferior position?

F′ E′ D′ should use the "Special Method" and go into column at right angles, heading either East or West. It is true that during the process F′ E′ D′ pays the penalty of the inferior position, but on the completion of the manoeuvre A′ B′ C′ *must* go into some other formation than line, or suffer the consequences.

As a tactical problem, it will be interesting to review the theoretical "Battle of the Azores" of August 9, 1903, between the British fleets B and X, as given in Brassey's Naval Annual for 1904, pages 69 to 85, to which the reader is referred for numerous details.

B fleet was composed of 14 battleships whose best speed at the time was from 11 to 12 knots, and the X fleet of 10 battleships whose speed was 15 knots. X had not intended to permit action, but B gave X "such an advantage that he took it," according to the official report. Really X decidedly failed to take it. Passing over the intermediate manoeuvres by which B's column approached from 14 miles to within 5 miles of X's column at 3.00 p. m., we will take up the narrative when action opened at 3.18 p. m., at 7,000 yards, and became general at 3.30 p. m. at about 5,000 yards, at which time the two fleets were in the relative positions shown in Figure 32, in which the rear ship of X was only 4,340 yards from the leading ship of B's formation and got the concentrated fire of six of B's leading ships. Compare the formation of X at this juncture with that of A B C in Figure 25, and note also that B, in order to close with X, has to approach steering South, *i. e.*, having practically to use bow fire. In Figure 33, fifteen minutes later (or at 3.45 p. m.), B is steering SSE., using bow fire, and does not go into column heading

FLEET ACTION, *August 9th*. POSITION AT 3.30.

X Fleet. Course changing from S.^{b} E. to S. E.^{b} S.

B Fleet. Course SOUTH.

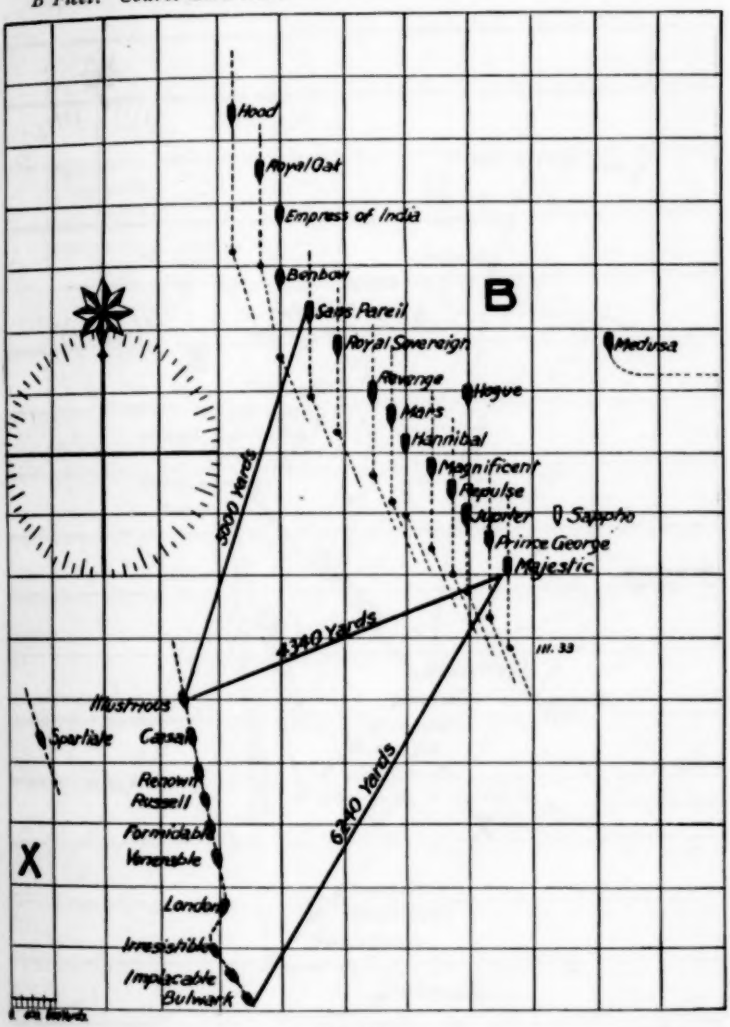

FIG. 82.

3.18 *Bulwark* signalled to 1st Division (Leading Division): "Open fire as soon as possible."

3.18 *Bulwark* opened fire at 7000 yards.

3.23 to 3.27 The remainder of X Fleet opened fire.

3.24 *Majestic* signalled to 2d Division (Leading Division): "Open fire."

FLEET ACTION, *August 9th.* POSITION AT 3.45.

X Fleet. Course S.E.

B Fleet. Course S.S.E.

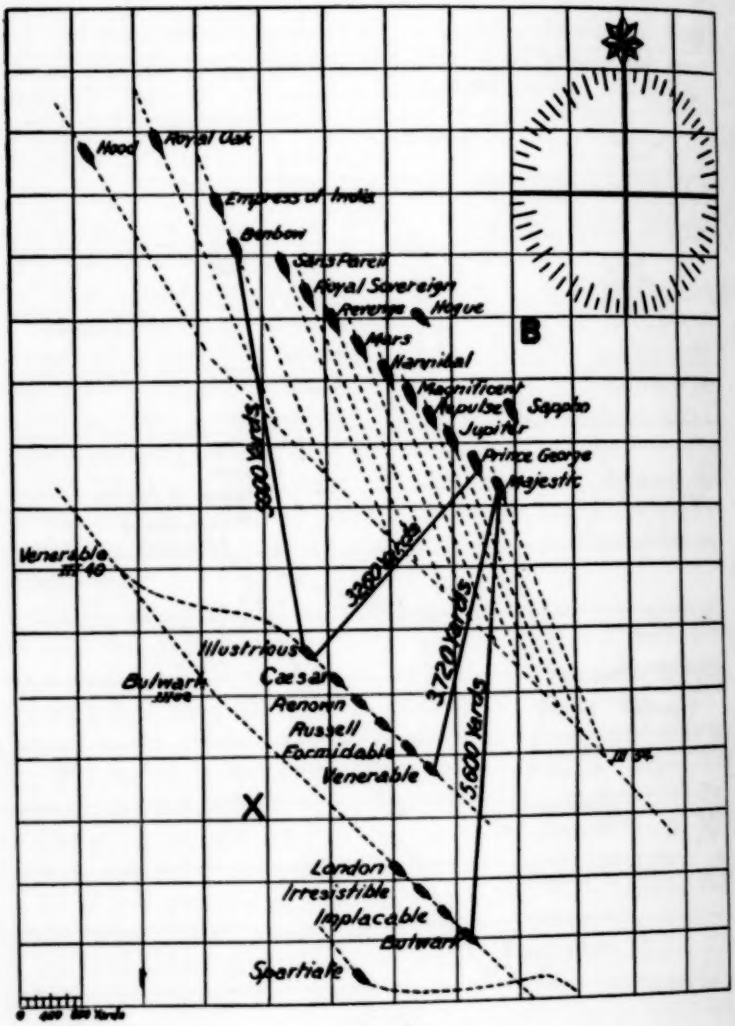

FIG. 33.

FLEET ACTION, *August 9th*. POSITION AT 4.

X Fleet. Course E.S.E.

B Fleet. Course S.E.

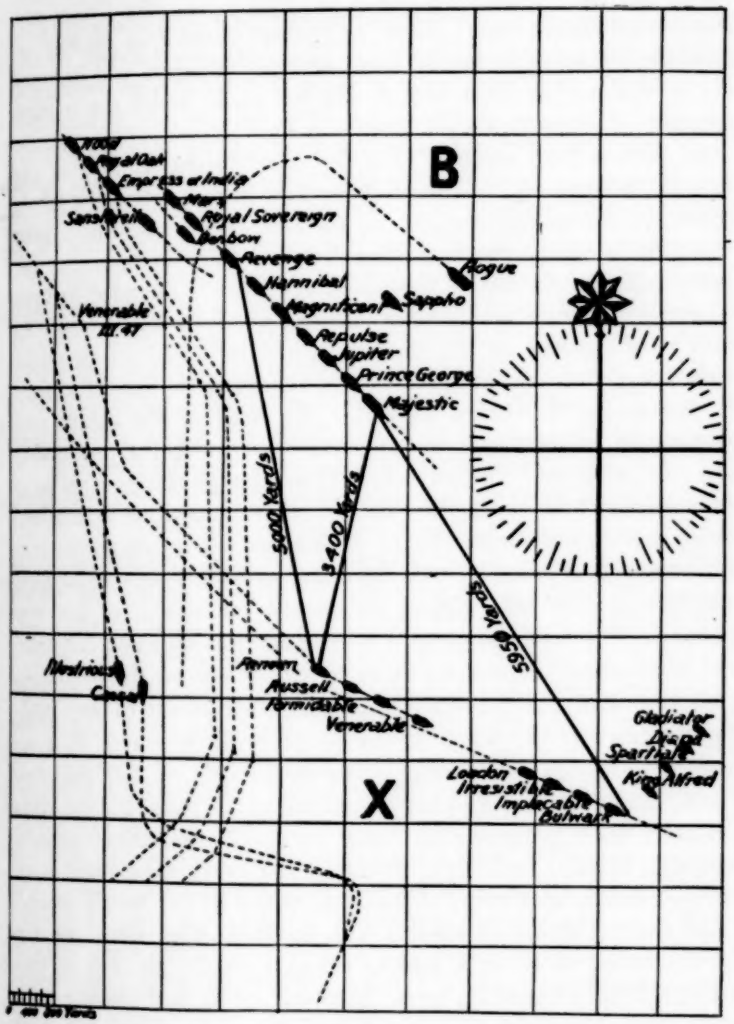

FIG. 34.

3·51 *Cæsar* and *Illustrious* left the line.

4.2 2d Sub-division of B Fleet was ordered to chase the *Cæsar* and *Illustrious*.

SE., parallel to the X fleet, until 3.54 p. m. Meanwhile the second division of X gets between the first division and the enemy by a mistake in signals (explanatory semaphore message), and in retrieving the mistake by signal at 3.50 p. m., the *Cæsar* and *Illustrious* (rear ships) made a further mistake in reading or interpreting an explanatory hand semaphore signal and dropped out of column, as illustrated in Figure 34, in which the relative position of ships is shown at 4.00 p. m.

In commenting on the "Battle," Mr. Thursfield says in the Annual, pages 74-5, "It is probable that in real action the whole course of the engagement, if not the final issue, would have been determined by the results of the first few minutes fire. But the action off the Azores, if fought as Admiral X intended to fight it, must, it would seem, have inflicted quite as heavy losses on him as it inflicted on his adversary, and its initial effects might have compelled him to fight it after all not as he wanted to fight it, but as his adversary wanted. No stage of the action subsequent to its first few minutes can be regarded as possessing any real actuality. In these first few minutes things must have happened in both fleets, the effect of which must have determined every subsequent disposition on both sides. It makes no material difference how long it took for these critical things to happen, whether it was ten, fifteen, or twenty minutes after fire was opened. The essential point is that as soon as they had happened any subsequent disposition made by either side on the hypothesis that they had not happened was altogether bereft of any intelligible relation to 'what would be probable in war.' It is altogether outside every imaginable probability of war that two fleets should be engaged for a quarter of an hour, several ships on both sides being within 5,000 yards of each other, without palpable results, such as must determine every subsequent stage of the action, and every disposition which either would make."

If the foregoing comments are justified, what could we say as to results to B of X having taken a formation such as that of A B C in Figure 25, using superior speed, and playing upon the earnest desire of B for action, B having a superior number of ships. There is, however, from pages 69 to 85 of Brassey, not the slightest intimation from any source that X's formation was under the circumstances fundamentally wrong, and that B had not the remotest tactical justification in reason for approaching

X in column, or as the British call it "line ahead." Some of the "critical things" which did happen were mistakes in reading or in interpreting supplementary semaphore signals. In action *what* would happen if, in time of peace, with no disturbing gun fire, numerous expert signalmen fail to get, and especially selected officers fail to grasp, the intent of signals of many words sent by semaphore to explain or modify tactical signals? There is no use wasting coal and oil with battleships in our navy until the steam launch, or pulling boat period is gone through with, and, if we are sufficiently elementary, we may even go back to the kindergarten method of practising, on a marked field on shore, with men representing ships with 45° bow and quarter fire represented by wooden frame work. This is not meant in the slightest degree as a comment on the exercises in question, or in criticism of actual, valuable, and admirable tactical and practical British exercises here reproduced in outline, but it is meant to emphasize the importance in our navy of *studying formations in relation to gun fire in order to reduce the necessity for signaling to a minimum, i. e.*, to make it a "captain's fight" in the sense in which, if the flagship drops out through damages sustained, the battle goes on because the plan is well understood *by many officers.* Admiral X, with superior speed, has only to choose his position in order to wipe out the head of B's formation eager for action.

This is well illustrated in the Battle of the Sea of Japan on May 27, 1905. The Japanese squadron appeared to the Russians about 1.45 p. m. Admiral Togo says, "we steered Southwest *as if* steering a route directly opposite to that of the enemy." Suddenly, at 2.05 p. m., he changed course to East and headed across the head of the Russian columns. One Russian report explains the Japanese movement as follows: "Finding himself at a great distance from our line of advance, the enemy suddenly headed to port and turned his broadsides against us. They literally overwhelmed our vessels with a hail of projectiles, concentrating their fire generally upon our flagships or upon the leading ships. Beginning with explosive shell, they tore away our smoke stacks, masts, and entire superstructures and set us on fire before using armor-piercing projectiles." Admiral Enquist's report states that the Japanese squadron "manoeuvred to prevent our following our route towards Vladivostok. Each time that

our squadron directed its course towards the North, the Japanese ships, by their superior speed, got ahead of our column of battleships and attacked whichever one of them was the leader. Fifty minutes after the fight began, the *Osliabia* sank. The *Borodino* was put out of action; and soon afterwards the *Kniaz-Souvaroff*, on fire, without masts or smoke stacks, was likewise put out of action. The Japanese tactics obliged our squadrons to move in a circle around the transports and torpedo boats, while the Japanese vessels manoeuvred in an outer circle. On account of inferiority of speed, it was difficult to get out of this position." Admiral Togo says, "Our signal for action was made at 1.55 p. m. The result of the battle was settled at 2.45 p. m."

Speaking more generally, from all the data at hand, the Japanese ships at 15 knots circled back and forth around the Russian ships at 10 knots, concentrating on the leading ships with the astonishing result of sinking modern battleships by gun fire alone. The Russian tactics were confined to turning movements in an endeavor to parallel the Japanese formations, and, failing in that, to "countermarch" and thus try to escape crushing gun fire. The superior speed of the Japanese battleships enabled a few ships to overwhelm *in detail* a fleet immensely superior in numbers, and to escape the concentrated fire of even a portion of the Russian fleet. It was the reverse of the tactics of Admiral X in the "Battle of the Azores," and illustrates admirably the tactical value of superior speed.

The few tactical problems here illustrated show the practical application of some of the tactical axioms. The limits of this paper preclude the posibility of formulating tactical rules for all cases. As a matter of fact rules apply only to a given relation, temporary or otherwise, between two opposing fleets. As we have seen, an advantage gained by a skillful manoeuvre may be lost by a counter move of the enemy, and can only be held, or regained, by either *superior speed*, or by *superior tactical skill*. If we understand the principles, rules are unnecessary.

The superior position implies that the chances are favorable, and that the inferior position must pay the penalty before it can retrieve itself, but we must always realize that a lucky shot may turn the scale by destroying the initiative of the fleet which has, up to that moment, had all the advantage. Luck of this kind, however, generally favors the side which has the better training and the greater skill.

TACTICAL PROPOSITIONS.

In order to successfully handle a fleet in action the individual ships must be well handled. To do this there are certain things or certain information which must be accurately known or quickly ascertainable. These are (1) the compass course; (2) the speed; (3) the distance and bearing of the guide and of adjacent ships in the formation; (4) the import of signals displayed; (5) the plan of action; (6) the distance of the enemy or of that portion of the enemy designated as the target; (7) the speed of the enemy; (8) the resultant allowance to be made on the sliding leaf of gun sights to compensate for (a) the speed of the ship, (b) the speed of the enemy, and (c) the direction of the wind; (9) the readiness of each division of the battery to fire; (10) the readiness of each torpedo tube to fire; (11) the helm angle; (12) the intactness of the hull; and (13) the degree of heel of the ship.

On the one hand, some officers claim that our ships are overloaded with delicate mechanical indicators which will probably get out of order in action; and, on the other, that the captain cannot possibly look out for so many things in action as the mechanical fittings imply. It is therefore well to pass in review the many duties of the captain in order to see what may be done to take as many details as possible off of his mind without weakening his effective control. From this we may decide what instruments or means of interior or exterior communications are necessary, and what personal aid is required to assist him properly in his manifold duties and responsibilities. We must consider also the contingency of a successor having to take command quickly in case of accident to the captain so that he may assume charge intelligently. If we therefore first select out what the commanding officer must do and must know, we may be able to determine what other officers must know and be able to tell him, or do and thus relieve him of some of the details.

Looking broadly at the duties of the commanding officer in action, we may note that the ram is completely under his control, because ramming is a question of helm and speed. With fixed torpedo tubes, torpedo firing is somewhat dependent upon him, being a question of aiming by means of the helm. In order to avoid wasting ammunition and injuring friends, gun fire must be under his direct control by mechanical signal or otherwise.

When signals are received which involve a change of course, or speed, or the use of weapons, the commanding officer is responsible for the execution of the order, or for the position and performance of the ship in obedience thereto. With this much as a guide, we may consider in detail the things enumerated above in relation to the captain's duties and responsibilities.

(1) *The Course.*—The captain cons the ship, assisted by the navigator and a quartermaster, whose duties consist, in this respect, in seeing that the ship is maintained on the course designated. The helmsman uses a definite compass course, and the more skillfully he maintains a steady course the better the gun trainers can do their work. Frequent changes of course disturb gun fire. This point must be kept in mind by both flag and commanding officers in connection with gun fire. What is important *tactically* is the relation of the course being steered to that being steered by the enemy. The flag officer has to consider this, and it is equally important for the range-finding party on each ship to know this, because, if the courses diverge or converge, the range changes rapidly and this affects gun fire. In changing course by signal it is therefore more rational to signal a change of so many points, rather than to signal the new compass course, and it certainly simplifies battle signals to do this. The helmsmen in the fleet steer the same true or magnetic course, but not necessarily the same compass course. Tactically the compass is of no importance *per se.* The gun fire diagrams speak of quadrants of 90°, but not in the compass sense, of say North to East, *but in relation to the angular difference between the compass courses or lines of bearing of the opposite fleets, from zero degrees when parallel to* 90° *when at right angles.* We must divorce in our minds utterly the mariner's compass from the gun fire and tactical diagrams. The compass is shown in the illustrations merely to start from a fixed direction and to discuss changes of course or bearing on the familiar angular basis. If we see this clearly then we will see that the captain does not personally concern himself other than in keeping his ship in the formation as steadily and with as little disturbance of gun fire as possible, and in this he is assisted by others. The consideration of the course being steered in relation to that of the enemy is for the flag officer, and the necessary mental arithmetic in computing the varying ranges is for the range finding party.

(2) *The Speed.*—A ship's speed is governed by the number of revolutions of the main engines. These should be shown on the bridge and at central station for each engine by mechanical indicators. Usually a mechanical annunciator is used to signal each engine what to do, the gradations being "full speed," "half speed," and "slow speed" ahead and back, with "stop" as an intermediate position, but tactically the ordinary annunciator is inadequate because station or position is usually kept by voice tube, or mechanical means whereby adjustment of position is affected by slowly increasing or decreasing the number of revolutions. Tactically there are several gradations of speed not recognized by the ordinary annunciator. A division, squadron, or fleet is usually manœuvred at "standard fast speed." "Standard full speed" is the "reserve" speed of all ships. "Full speed" is an individual ship's best speed, independently of any standard. While the engines are seldom used to assist the helm in turning in general tactical evolutions ("standard helm" being used) yet for the purpose of a single ship, to aid in ramming or in torpedo aiming, the engines may be used with good effect. Speed cones are used to indicate to other ships in formations the performance of the engines, but too much reliance cannot be placed on these in action. It would therefore appear that frequent drills in tactical evolutions can alone attain that degree of efficiency which will enable fleets to dispense with them. The course and speed are therefore two of the considerations resting on the captain and his immediate and personal assistants. But there are others.

(3) *The Distance and Bearing of the Guide and of Adjacent Ships in the Formation.*—Either a sextant or a Fiske stadimeter is used to determine the distance of various ships in the formation. The bearings may be obtained by a "tactical square" painted on the deck of the bridge, or by a pelorus, or dumb compass. The officer charged with keeping the captain informed of distances and bearings should be on the bridge as a personal aide with additional duties as signal officer. It is in no sense the duty of the range finding party, but is one of the things the captain must consider personally at critical times, especially in changing formations.

(4) *The Import of Signals Displayed.*—Battle signals should be few and simple, corresponding to a few well understood movements. There should be a plan of battle and definite rules where-

by in the absence of signals logical and definite course of action may be pursued in certain contingencies, such as flagship injured, guide dropping out, etc. The day of battle is no time to improvise methods of signalling, and to send long semaphore or improvised messages, explanatory of hastily formed plans. The hand semaphore is all right for conversation, but is a poor substitute for a plan of action. Also under any system the captain will have enough on his mind without having to search through signal books for all kinds of signals. He must have a number of people on his personal staff to make and receive signals, and take details off his mind, but just the same he must be sure of the signals, for mistakes are expensive.

(5) *The Plan of Action.*—As stated previously, a good plan of battle will minimize the necessity for signals, and reduce the chance of errors and misunderstandings. The captain should not be the only one to know this. The executive, navigator, and personal aides as well as the range finding officer should understand it thoroughly.

(6) *The Distance of the Enemy.*—This brings us to some of the considerations involving fire control through spotting the fall of shots, and through range finding as a fine art. Trial shots with accurate spotting at ranges based on as reliable a method of range finding as can be devised are the fundamental elements of battle practice, assuming that there are no serious defects in ordnance, and that proper training has been employed in teaching gun captains to shoot straight. A range finding party *for each calibre of gun of the main battery,* consisting of officers and trained men, should be stationed in the tops with range finders, sextants, stadimeters, etc., to determine the range and lateral correction of sights, and to watch the fall of shots. The range selected should be that of the portion of the fleet designated as the target. By means of a set of clock like indicators facing downwards from each top occupied by a fire control group, the range should be shown to those on deck whose business it is to see it, but in addition the main reliance should be mechanical indicators to signal to each gun station the ascertained range. The visible dial in the top is merely a second means of information in case of accident to the mechanical indicators for each gun station. The captain may or may not correct the given range, but it is manifestly impossible that he should handle ship, and at the same time estimate ranges from moment to moment.

(7) *The Speed of the Enemy.*—This being a matter of calculation from actually observed changes of bearing, based on speed and course of both fleets, it should be the duty of the range finding party to ascertain this, and embody it in the estimates of change of range.

(8) *The Resultant Allowance to be Made on the Sliding Leaf of Gun Sights to Compensate for* (a) *Speed of Ship* (b) *Speed of Enemy, and* (c) *The Wind.*—This compensation is the duty of the range finding (fire control) party to estimate. By means of a second dial displayed from each top for each calibre of guns, and by means of mechanical transmitters to each gun station, the correction for lateral error *in feet on the target to right or left* should be signalled. Graduations of the sliding leaf in minutes of arc, or knots, are possibly accurate but anyone can, independently of distance, estimate with the eye a certain number of feet on a given ship's profile, rather than use angular (arc) measure. The dials should therefore show *feet* to right or left in multiples of 5. The visible dial in the top should supplement the dials at the guns in case of accident.

(9) *The Readiness of Each Division and of the Battery to Fire.*—Fire control is imperative. It prevents waste of ammunition, interference, and danger to friends. Even with smokeless powder the interference of guns from powder gases when all of one battery are firing is very serious. Broadside volley firing with all guns of the same calibe is a modern up-to-date necessity. Isolated gun positions make this a question of mechanical communication. If a reliable mechanical instrument is found to be necessary for any form of communication, its invention and installations is merely a question of money. In conning towers there is usually an electric battery indicator which works well. The captain, through the range finding party, must exercise fire control. Mechanical details will be considered later.

(10) *The Readiness of Each Torpedo Tube to Fire.*—In some ships the torpedo director is in the conning tower. In others it has a separate station. Until the tube gate is open the torpedo cannot be discharged. Unquestionably torpedo fire control should rest with the captain independently of the battery fire control, because the helm must be used but principally because the responsibility rests with him.

(11) *The Helm Angle.*—As the course is controlled by the

captain the information as to the helm angle should be quickly available. Usually a mechanical helm indicator is installed, but the helmsman also necessarily knows the helm angle except in case of certain accidents to the steering gear.

(12) *The Intactness of the Hull.*—Usually there are water alarms which mechanically indicate the presence of water in compartments. The flooding of one or more compartments produces changes in the trim of the ship, affecting the steering, the speed, the armor protection, and battery efficiency. Knowledge of this enables the commanding officer to give orders to stop leaks, or to have the compartment pumped out, or to trim the ship by flooding others.

(13) *The Degree of Heel of the Ship.*—There is usually a mechanical indicator for this. Heeling principally effects the armor protection and the efficiency of the battery.

A consideration of the needs of interior communication in battle brings us to the question of the conning tower and protection of the captain and his assistants. There is a growing feeling that the real conning tower, as now fitted, should be below the protective deck with an armored tube communicating with the bridge deck. Through this tube all orders should be given, megaphone like, to the central station below. The bridge should be free from every form of iron stanchion, protection to personnel, or any fitting which will arrest the flight of projectiles or tend to explode their fuses. The captain and his assistants on a perfectly clear bridge are in less danger than with partial armor protection. In case of injury to the sets of indicators on the bridge, reliance will have to be had on communication through the armor tube.

Of the various requirements for communicating information and orders in a fleet and on board ship it is well to condense them in the form of tactical propositions.

1st. As many methods of interior communication should be available in each ship as will enable the captain and his assistants to handle her efficiently.

The things which the captain has under his complete control are (a) the course, (b) the speed, (c) the ram, (d) the gun fire, and (e) the torpedo fire.

The things which the captain ought to be able to ascertain quickly or to give orders concerning by means of interior communication or mechanical instruments, or through personal as-

sistants, as occasion requires are (1) the compass heading of the ship, (2) the helm angle, (3) the revolutions of the engines, (4) the distance and bearing of any ship in the formation, (5) the meaning of any signal made, (6) the readiness of each division of the battery to fire, (7) the readiness of each torpedo tube to fire, (8) the intactness of the hull, and (9) the heel of the ship.

The captain should have on the bridge with him, the navigator, a signal officer, and a detail of quartermasters and signalmen to keep track of things and to transmit orders.

Speaking tubes to the central station should be distributed at various points to enable the ship to be handled in case the bridge itself is wrecked by a shell.

2d. There should be a range finding (fire control) party for each calibre of gun in the main battery located in separate tops to regulate the gun fire.

The instruments needed in each top by each range finding group are: (1) a reliable range finder; (2) a sextant; (3) a stadimeter; (4) a dumb compass; (5) a stop watch; (6) printed range tables; (7) a mechanical range computer; (8) powerful glasses to watch the fall of projectiles; (9) a large dial for indicating ranges to deck; (10) a large dial for indicating lateral corrections to deck; (11) mechanical transmitters or annunciators to all gun positions of the particular calibre; (12) a voice tube to central station, and (13) an alarm bell or buzzer to cease firing, which signal should be given by the captain, *through* the range finding party, using the mechanical transmitters.

3d. Signalling between ships is merely a means to an end, and, while this end can be attained with the minimum of signalling by perfecting the rules of tactics, yet every known method of transmitting the necessary signals should be available for battle, so that if one fails another may be used.

Next to straight shooting at battle ranges, and proper tactical dispositions, looms up the great and generally misunderstood question of battle signals. *There should be but one code of signals, but all possible methods of transmitting it.* For instance, by the four lamp electric night system we can transmit the Army and Navy code of thirty characters with the utmost rapidity, visible from four to five miles, and covering every conceivable purpose of signalling. It appears that sending this same code by hand wig wag flag was found to be too slow. Instead of

taking thirty characters from the hand semaphore and *using them as a rapid method of transmitting our regular code,* we have deliberately gone out of our way to adopt a foreign hand semaphore *code* which as a code is in no way superior, has no resemblance to our own, and has the doubtful merit that we can communicate with the foreign ships using it. If peace cruising is the criterion of signalling, this consideration has weight, but for a battle code in our Navy this foreign hand semaphore code is useless and should be curtailed in its use to transmitting the thirty characters of our regular code. The four arm semaphore transmits our code admirably at greater ranges than the hand flag or two arm semaphore, but no one can deny that the latter is a good adjunct for short distances, but there is no merit in taking the British code when we can use our own just as well.

In the same way our flag system of one to four flags in a hoist should be made to correspond to our thirty character code. Incidentally all code calls should be abolished and our signal book numbers be run consecutively from 1 to 35,000. With thirty flags corresponding to the thirty characters in the Army and Navy code and with a straight signal book there are no requirements of signalling in peace or war which cannot be readily met. This contentious digression is only meant to show the importance of *one code and many methods* vs. *the many codes and many methods into which we seem to stumble* through losing sight of fundamental principles.

In the regular code some characters have two meanings. It is proposed to expand the thirty characters into a battle code by giving meanings to letters now having but one signification, the "Interval" excepted. As here given the regular recognized secondary meanings are in parentheses and the proposed secondary meanings for unassigned characters are given in quotation marks. Thus:

A = "*Auxiliaries*" ..... = 22
B = (Zero) ..... = 2112
C = (Repeat) ..... = 121
D = "*Formation*" ..... = 222
E = (Error) ..... = 12
F = (4) ..... = 2221
G = (6) ..... = 2211
H = "*Leader*" ..... = 122
I = "*Direct Method*" ..... = 1
J = (5) ..... = 1122

K = (Negative) ..... = 2121
L = "*Left*" ..... = 221
M = (9) ..... = 1221
N = "*Cease Firing*" ..... = 11
O = "*Commence Firing*" ..... = 21
P = (Affirmative) ..... = 1212
Q = (Interrogatory) ..... = 1211
R = "*Right*" ..... = 211
S = "*Special Method*" ..... = 212
T = "*Torpedo Boats, etc.*" ..... = 2
U = "*Reserve Speed*" ..... = 112
V = (7) ..... = 1222
W = (Annual) ..... = 1121
X = (Numerals) ..... = 2122
Y = "*Concentrate on—*" ..... = 111
Z = (2) ..... = 2222
Cornet = (1) = "*Execution*" ..... = 1111
Letters Call = (3) ..... = 1112
Battle Code = (8) ..... = 2111
Interval ..... = 2212

This battle code is based upon the considerations previously explained as follows:

1st. The course. This can be changed by all ships changing course at once (simultaneously) or by the leader or leaders (in compound formations) changing and the others following (successively).

2d. The bearing of the leader in any rectilinear formation.

The object of this battle code is to transmit many tactical and battle signals which can be understood at once without reference to a signal book, thus reducing the list of battle signals to a *minimum*.

By this code the letters "A," "T," and "D," are prefixes or distinguishing letters as follows: "A" means that the signal which follows is for the auxiliaries and reserve ships; "T" means for torpedo boats, torpedo boat destroyers, and scouts armed with torpedoes; and "D" means all groups, divisions, or squadrons in a compound formation such as double column, double line, etc., or in other words, where the fleet is subdivided, it means for all ships. With no prefix a signal is for the group commanded by the flag officer making the signal, or, if all ships are in one formation, then for all ships in the line of battle.

Simultaneous changes of course are signalled thus: R 5 which means "Ships turn through five points to the *right*," or R8

"through eight points," or L6 "ships turn through six points to the left."

A successive change of course is signalled thus: H L 4, which means "Leader turn four points left," or H R 6, "Leader turn through six points right." (This is the "Rectangular Method" of changing line of bearing.)

Changes in line of bearing are signalled by displaying a numeral before a tactical letter. Thus: 4 H R means, "Leader bearing four points to the right" (échelon), or 8 H L, "Leader bearing eight points to the left" (line), or 0 H (Zero H) "Leader bearing right ahead," (column).

In case of compound formations, such as double column, a signal such as D 4 H L means, "In all formations the respective leaders bear four points to the left" (groups in échelon), or D R 4, "Ships in all formations turn through four points to the right."

To go from one formation into another by the rectangular method, say from column into échelon, implies merely signalling a change of direction of the Leader the required number of points, thus, H R 4. To accomplish the same movement by the special method or by the direct method requires that the new line of bearing be signalled thus, say the ships are in column and go into échelon to the right 4 H R S. "Leader bearing four points right, using the special method," or 4 H R I same but use "direct method." To commence firing is signalled by "O," and to cease firing by "N." Concentration of fire is signalled thus: Y 6, "Concentrate on enemy's 6th ship counting from leader." This code is put in operation by signalling 2111, "Battle Code Use." At any time to revert to a spelled out message it is only necessary to signal, 1112 "Letters Call or Alphabet Use." While using the battle code, the regular signal book is always in full operation, because, unless the letters A, D, H, I, L, N, O, R, S, T, U, or Y are used with numerals, any numerals signalled are read from the signal book. In other words in battle the "Battle Code" does not supersede the signal book ("G. S. U.") and is merely an admirable supplement to it saving time, and being readily understood.

If this code of thirty characters can accomplish all this, is it not important to adapt all our *methods* of signalling to the transmission of the Army and Navy *code* by flag hoist, by four arm semaphore, by wig wag, by hand semaphore, or by any other

means by which we may make these signals by day or night in any kind of weather? It is thought that a fleet can be manœuvred tactically by these battle signals without the use of a signal book, but nevertheless it should be thoroughly tried in order to remove the taint of theory from it, and in order to enable the officers of the fleet to expand, modify, or improve upon it practically.

4th. The flagship of the line of battle should be a battleship and its position should be in the centre of the formation rather than near the ends of flanks.

This applies to the flagship of the commander-in-chief. There may be rear-admirals in command of divisions and the second in command may even have command of the armored cruiser division, if there is one, but the commander-in-chief belongs to a battleship in the line of battle.

5th. The rôle of the armored cruiser is that of scout and destroyer of everything but battleships.

In defensive tactics their superior speed enables them:

(1) To protect auxiliaries.

(2) To support smaller scouts and torpedo boat destroyers.

(3) To help protect injured battleships that may fall out of line of battle.

(4) To form a reserve for the line of battle in order to support it at critical junctures.

In offensive tactics, after engagement has progressed a short time, an undamaged armored cruiser has many advantages over a damaged battleship, and its mission is to destroy any vessel of the enemy it possibly can.

6th. The tactics of a fleet greatly inferior in point of numbers or in type of ships should be to bring on an engagement, if at all, in narrow waters well known to its officers.

7th. The reserve should be made up of slower ships and all classes of *impedimenta* or auxiliaries, and should be protected by torpedo boat destroyers and protected cruisers (if any) with armored cruisers as a support. The rôle of the reserve is to avoid action until such time as it may relieve a weak position or follow up an advantage gained. Such protection as the line of battle may afford the reserve should be given without sacrificing the initiative.

8th. Under average conditions the best initial formation for the approach to the attack is line at right angles to the bearing of the centre of the enemy's formation.

In order to close with an enemy it is necessary to steam towards him. While doing this only the bow guns can be brought to bear and these represent but 43% of the maximum fire of broadside, but if you are forcing the action you must use bow fire at some stage or other, and it is better to use it at the preliminary long ranges at the beginning of an engagement. In the line formation here spoken of ships may oblique as much as six points to edge towards a superior position, but the main thing is that the *line of bearing* shall be at right angles to the bearing of the enemy, thus bringing all the ships into action at once and on equal terms. In thus approaching none of your ships have to bear the entire brunt of the enemy's fire as would be the case in approaching in column. This line formation is merely tentative. Once within the zone of fire line of bearing and course may be changed according to circumstances. "Under average conditions" means that it is not always well to use line formation for the approach to the attack, but the exceptions will be found sufficiently rare to make it a general rule.

9th. In concentrating gun fire on a portion of the enemy's formation from a superior position the secondary object should be to oblique or edge closer so as to force home the advantage while it lasts.

Closing in on the enemy, or surrounding or overwhelming by gun fire, as described by Admiral Enquist in the Battle of the Sea of Japan, is variously described tactically as "concentration accompanied by constriction" or as "enveloping," but under any name it is forcing the issue while at the same time avoiding a melee.

10th. Chase should always be given when opportunity offers.

Chasing has the drawback of exposing your ships to torpedoes, or floating mines in the wake of the enemy's ships, and also of the danger of being cut off by a superior force when distant from support, but it has the advantage that all the chances are in its favor in case of accidents to motive power or steering gear of ships of the enemy, causing one or more to straggle or drop back. Being thus at a disadvantage they are more easily destroyed or captured. A lucky shot may bring a ship to, or changing weather conditions may prove favorable to overtaking.

The few tactical propositions here enunciated are added to the general consideration of the elements of fleet tactics in order

to suggest study and discussion. No attempt has been made to outline a consistent scheme of tactics. What has been here said is merely an introduction to the study of fleet tactics along sound lines. It has been as much a process of elimination as of constructive reasoning. The fleet is the school of tactics, but the training must be from the simple to the complex. It is manifestly impossible in the limits of this paper to treat of wireless signalling, of commerce destroying, of scouting, of reconnaisance in force, of safety service, of auxiliaries, of torpedo boats, of torpedo boat destroyers, of the reserve, or of submarines and mines in their relation to the tactics of a fleet, nor has ramming been considered. It has only been possible to consider the tactics of the line-of-battle independently of all accompanying ships. It is, however, inconceivable that a squadron of nine battleships should be unaccompanied by ships of many types. The treatment of tactics is therefore essentially elementary.

The study of military tactics is important as affecting the strategy of campaigns but it has no bearing on the study of minor naval tactics as here considered. As expresssed recently by a distinguished foreign naval officer, " In land warfare small bodies of cavalry may one day act as independent patrols or scouts, and the next day they may form an integral part of a regiment, but in naval warfare no such integration of the units can be effected; no number of small cruisers can, by acting together, become the equivalent of a large cruiser." The difference between military and naval tactics are fundamental.

The writer's aim has been merely to clear away some of the misconceptions which seemed to shroud the subject of naval tactics and to offer for study consideration the basic elements of fleet tactics.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

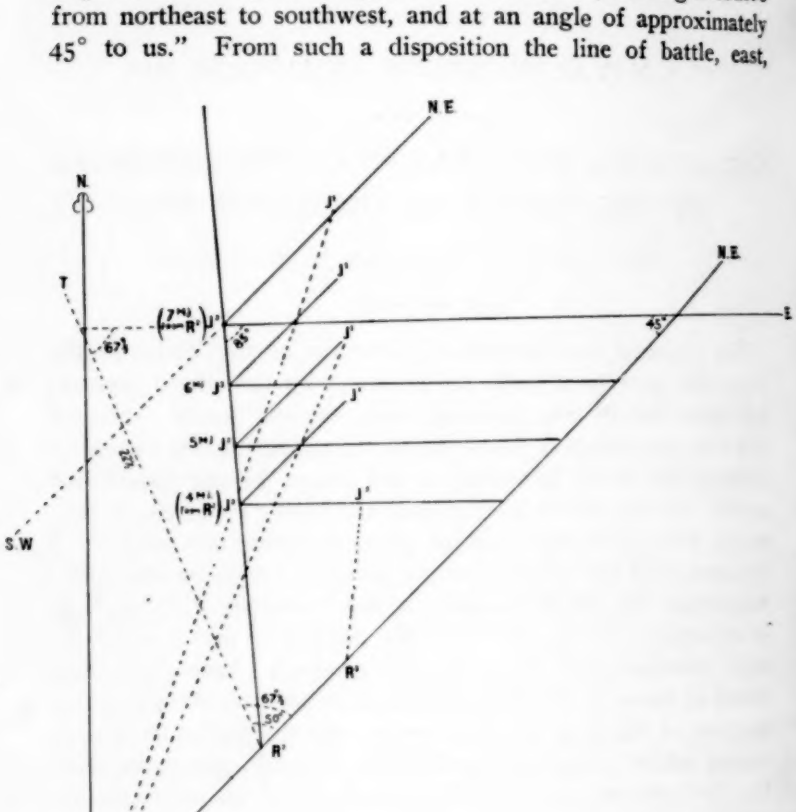
REFLECTIONS, HISTORIC AND OTHER, SUGGESTED BY THE BATTLE OF THE JAPAN SEA.

By CAPTAIN A. T. MAHAN, U. S. Navy.

The principal and determining features of the Battle of the Japan Sea have been made known to us by the official reports; but many details are wanting, and, as was justly remarked in a very able article in Blackwood's Magazine for last February, probably can never be supplied, the drama having passed too rapidly, and the actors having been too busily occupied, to take precise notes. The writer of the paper therefore devoted part of his space to an investigation of the problem, and to an attempt to reconstitute the earlier features of the engagement, as well as its subsequent phases. It is to this discussion that I owed the study embodied in the following plan, in which I have also availed myself of some of his data, more particularly with reference to the train of the guns of either party; but the particular line of enquiry which I have followed differs, I think, somewhat from his. It is in any event merely tentative; and its principal use, except as an attempt to solve a question of reasonable professional interest, lies in familiarizing the mind with some of the conditions of the encounter, and so making more easy the reflections which appear to follow naturally, from considering the relative position of the combatants.

Admiral Togo in his report says that at 1.45 p. m. the Russians were first seen from his flagship, "a few miles to the south." As they were known to be heading northeast, he then steered southwest, to deceive them into the impression that he meant to pass by in an opposite parallel direction. He does not report whether his fleet during this demonstration was in line abreast

or line ahead. The latter might readily be presumed, but I have seen no positive statement to that effect; whereas one Russian account explicitly says: "A little after 12,* seventeen powerful ships of the enemy were sighted, in line abreast, holding a course from northeast to southwest, and at an angle of approximately 45° to us." From such a disposition the line of battle, east,



could be instantaneously formed. However, whatever the first formation, the southwest course continued till 2.05 p. m., when it was suddenly changed to east; three minutes after which, or at 2.08, the Russians opened fire, having, however, before that "slightly changed their course to the right,"—kept off. Up to

* The other times of this account are a half-hour fast.

that time they had been steering northeast, at a speed of about twelve knots.

Nothing definite, either in distance or bearing, is herein given about the positions, or speeds, of the Japanese. Assuming R^1 as the Russian position when first seen, we have from it the course, northeast, and the time, twenty minutes, one-third of an hour, to the moment when Togo headed east. As the Russian speed was about twelve knots, laying off four miles on a northeast course gives us R^2, as the position of the head of the Russian column at the same moment. R^1 and R^2 are assured positions. Now, as the full force of the Russian broadside could only train 40 to 45 degrees forward of the beam, it seems reasonable to conclude that the Japanese admiral would execute his change of course either by the time the guns could bear upon him, or at a distance when their so bearing would not be very material; while he would keep coincidently in view the train of his own guns, which was slightly less than that of his opponents.

R^2 being the position of the leaders of the Russian left column at 2.05, I draw the line R^2 J^1 making with the northeast course an angle of 50 degrees, giving a compass bearing of N. 5° W., or 40° forward of the Russian beam. This is conjecturally the bearing of the head of the Japanese column when round to an east course, and as part of the Russian battery would then bear but scantly, the movement of keeping off, which ensued at once, and before opening fire, would be natural. Upon the line R^2 J^1 lay off by scale the distances four, five, six, and seven miles, which in yards would be respectively eight, ten, twelve, and fourteen thousand. Like the bearing, these distances are conjectural, but the truth very probably lies somewhere between the two extremes. Accepting them successively, and laying off from each a compass northeast, we have for each the southwest line down which the Japanese ran while the Russians were moving northeast four miles, from R^1 to R^2. Admiral Togo has not favored us with his rate of steaming on this course; but as there was no cause for haste, rather the reverse, I presume he did not go over two or three miles to the Russian four. Taking such distance as rather less than three miles, we get the several positions J^1, corresponding to R^1, according to the several estimates of the distance between the opponents, at the moment when the Japanese went about and the Russians opened fire. By protractor and scale it ap-

pears that for a distance ($R^3 J^3$) of seven miles, the Russians when first seen by Togo bore from him S. 20 W., distant something over 12 miles; for a distance of five miles, S. 25 W., distant 10 2-3 miles. The latter is not improbable.

It is expedient to notice here one or two surface facts. By taking the general position he did, to which the several points J^1 are conjectural approximations, the Japanese admiral preserved to himself interior lines of movement—shorter distances to cover—whatever course the Russians might take, unless they retreated. That is, he secured for himself the certainty of bringing the enemy to battle, quite irrespective of any superiority of speed on his part. The course steered by each from R^3 and J^3, by their intersection complete a triangle, of which much the longer side belonged to the Russians. Not unless Togo, steering S. W., had continued to the line R^3T, bringing the enemy at R^3 to bear S. S. E., would the distance to be run have become equal; and the consequences of such continuance, entailing not only more distance to run, but more extreme train for his guns and less for those of the Russians, were too obvious to be tempting. Whatever use he made of this primary advantage, however, the admiral had secured it by the position taken, on full information. All things considered, the most commanding bearing on which to have the enemy was due south, and it is probable that he did not greatly depart from that to either hand before going about. Again, should both fleets continue on their respective courses, east and northeast, maintaining equal speeds—as to J^3 and R^3—not only would they draw together, but the Japanese, having the interior line, would draw ahead at their discretion, throwing the Russian broadsides more and more out of action. Further, in order to overcome this disadvantage, the Russians would need a speed of fourteen knots to a Japanese ten, or seventeen to a Japanese twelve; a difference of speed beyond that contemplated as possible, in clean bottomed ships, by either the advocates or opponents of very high speed in battleships. This difference in favor of the Japanese resulted from choice of position relative to the enemy's probable objects, and not from the superiority of speed they undoubtedly possessed.

Prior to the late war, the importance of speed to battleships was necessarily discussed and determined upon *a priori* reasoning. It will be well to see what further light may seem to be thrown upon the question by the events of the war itself. Concerning this

there is necessary the warning that such illustration is inevitably partial; for the instances are limited, and generalization from them must not be too dogmatic. As far as it goes, however, it will possess the advantage of the concrete over the abstract; and will itself give occasion to some theoretical reasoning based upon simple geometrical considerations, which to my own mind possesses weight.

Essentially, the Russian fleet in the late war was placed upon, and willingly accepted, the defensive. The battle of the Japan Sea is itself but an instance of this, for the Russian aim there was not to destroy the enemy, but to escape to Vladivostok. It was the cardinal, and, in view of the aggregate size of their navy, most discreditable feature of the campaign as a whole on their part, that no decided attempt was ever made to destroy the Japanese fleet by sheer hard fighting. This applies more particularly to the Port Arthur division in its general management, and especially in the two sorties of June 23 and August 10, 1904, in neither of which can be traced the slightest influence of the Nelsonic maxim, "By the time the enemy had beaten us soundly, they would do no more harm this year." Having thus neglected all opportunity of clearing the way for the Baltic division, and the Japanese having by the fall of Port Arthur obtained opportunity thoroughly to refit their fleet, Rojdestvensky was pretty well compelled to adopt first a defensive strategic object; that, namely, of reaching Vladivostok with as little fighting as possible, in order to put his own vessels as near as might be on a material equality of condition with their opponents, and also to associate to himself such other Russian ships as the place contained. His fleet was the last naval hope of Russia, as Togo's had all along been the sole naval reliance upon which Japan could rest; he was justified accordingly in wishing to put himself on the best possible footing before daring the issue that must in the end be dared, if the tide of war was to be reversed in Russia's favor. What bearing would the highest speed of his battleships have had upon his movements? That of unarmored cruisers is not here in account, one way or the other.

We know what actually happened, though that as yet imperfectly. Upon this chiefly we must reason, but are at liberty also to consider by the way alternative courses of action, open to the Russian admiral after his arrival in Far Eastern waters. By the

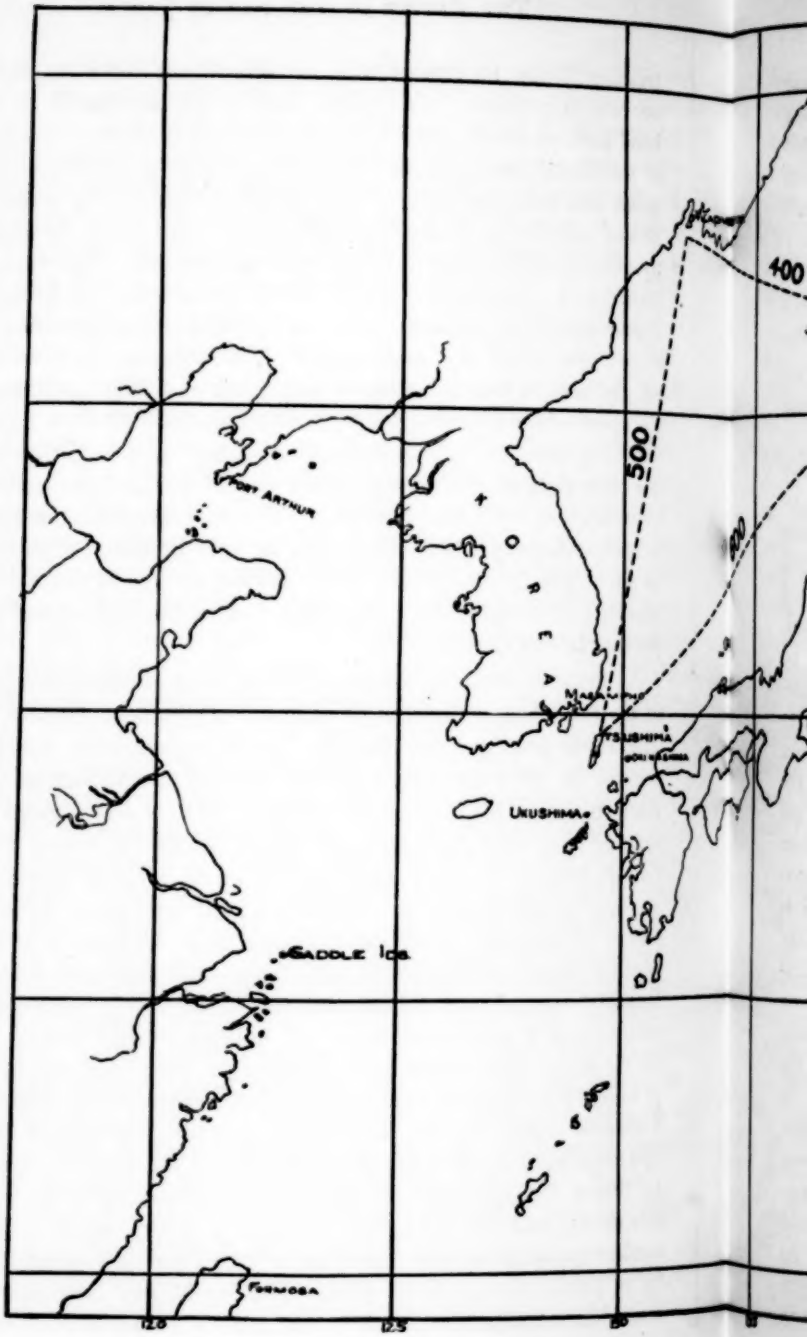
Naval Annual of 1905, the speeds of the chief battleships, whose names became familiar to us through the battle of Tsu-shima, were from eighteen to eighteen and a half knots. Without taking too literally this result over the measured mile, we may assume that the original speed of the chief battle force on either side was substantially equal, with a slight advantage in favor of Japan. It is true that this assumption somewhat traverses the exultation deriving from each quarter-knot extra speed on a trial trip; but it is not unsound in practice. Actually, the Russian fleet had a very long voyage before reaching the scene of operations, where its enemy already was; but, if the two had had voyages of equal length to make, the time of arrival—a strategic consideration—would have depended less upon the small difference of speed above given, than upon accompanying circumstances of weather, coal endurance, the quality of coals available, facilities and rapidity for coaling on the way, not to mention unforeseeable accidents. However, assuming that, whatever the relative experiences in these ways, the faster fleet arrives first, of what advantage would it be, if the gain of time has been due to speed obtained at the sacrifice of fighting power? The enemy on coming up keeps the field; or, if encountered and equally skillful, conquers in battle by superior force.

In the event, the Russian fleet arrived upon a ground long before held by its enemy; and the speed of its line of battle was gravely diminished by the fouling of the bottom inevitable in such an experience as it had undergone. Further, and of more general importance to the consideration before us, because of universal application, the speed of the faster ships had to be reduced to that of the heterogeneous slower vessels which had been added to raise the fighting power of the whole body. It is not likely that another modern fleet will soon again present such diversity of types as the last agony of Russia compelled her to assemble; but the fast battleship built this year will always find her speed conditioned and lowered in the same way by that built three years ago, so long as the standards of size and consequent speed depend upon the ship your neighbor is laying down. We are at the beginning of a series to which there is no logical end, except the power of naval architects to increase size.

In 1898, just after the war with Spain, I made this remark to the then Secretary of the Navy; saying that, on the path we were

treading, I saw no reason why we should not reach 20,000 tons, nor why stop there. He replied, that he saw no reason to apprehend such an issue. In a very recent number of the Proceedings of the Naval Institute, an officer with whose professional intelligence and thoughtfulness I have ample acquaintance, writes that he had asked a naval architect what sized ship would be requisite to embody all the high qualities now demanded. The reply was 30,000 tons. To this the officer would not accede, but he believed 20,000 would be needed. Why he thought the progression must stop there, I did not understand. The point to be tenaciously remembered is that the 20-knot-ship must as a rule come down to the speed of the 18 knot; for battleships are built to work together. The only case in which inequality of speed may be utilized is in the close pursuit of a flying enemy—what our forbears called "a general chase." There the faster ships may overtake the enemy's slower, and compel the whole body to fight or abandon them; but in such case, if speed have been gained at the sacrifice of gun power, the advantage is contestable, unless the main force of the pursuer is very close behind.

An instance partly in point was afforded in Kamimura's pursuit of the Port Arthur division of armored cruisers, in August, 1904. The *Rurik* having been disabled in the engagement, Kamimura pressed on after her two consorts, leaving the reduction of the *Rurik* to two of his unarmored cruisers. The *Rurik's* speed being reduced, and her steering gear damaged, the Japanese vessels, though inferior in force and only of equal original speed, were enabled to maintain their positions under her stern, where her power of injuring them was reduced to a minimum; and they kept her engaged until their armored vessels returned, when the Russians opened her valves and she sank. This presented the essentials of a general chase in the holding of an enemy's vessel till the main force comes up,—in this case, back; and the incident of inability to steer is precisely one of the determining features in a general chase, for the rear vessel in such case cannot deflect. She must keep on after her consorts; for, if she turns to fight, she facilitates the approach of the enemy's slower main body. To this chiefly was due the preponderance of injury received from a weaker opponent by the American frigate *President*, when chased by a British squadron in 1815. She could not turn upon her immediate assailant, because of the latter's consorts following at


400
500
PORT ARTHUR
TSUSHIMA
UKUSHIMA
SADDLE ISS
FORMOSA
120
125

V
45
40
35
30
25
100
STRAIT OF TSUGARU
300
140
145

a distance in her wake. So the British frigate *Penelope* hung effectively upon the quarters of the French 80-gun ship *Guillaume Tell,* seeking to escape from Malta in 1800, and contributed powerfully to her capture by the squadron, the approach of which prevented the ship of the line turning her broadside on her swift but petty foe.

At the meeting off Tsu-shima, in May, 1905, the Japanese battle fleet proper had over the Russian an advantage of two or three knots speed at the time when Rojdestvensky came abreast the north point of Formosa; the moment when the strategic campaign may be said to have opened. Of what determining advantage was this excess of speed to Admiral Togo? The latter had to consider that, granting the Russians had coal enough, it was open to them either to proceed by the straits of Korea, as they did, or to the east of Japan, coming out by the Tsugaru straits, abreast Vladivostok. By the latter route they must cover 2,100 miles, against 1,200 by the former. We are told that Togo remained convinced throughout that the shorter road would be taken; but, by the position in which he placed his fleet, at Masampho, he insured intercepting the enemy irrespective of relative speeds, though certainly not irrespective of the damaging accidents to which all military plans are liable. Masampho is but fifty miles from the north end of Tsu-shima, which may be regarded as the geographical center, around which revolved all operations, actual or possible. For the larger view of campaign issues, the two positions are identical. From Tsu-shima to Vladivostok is 500 miles; from the west end of the Tsugaru straits to Vladivostok is 400. Supposing Rojdestvensky to take the Tsugaru route, and the two fleets to have equal speeds of twelve knots—that maintained by the Russians—Togo, in order to intercept the enemy off Vladivostok, would need to know that they were not coming by way of Tsu-shima only nine hours before they cleared the straits; for he would have only 100 miles more than they to steam. If, instead of off Vladivostok, he should prefer to meet the enemy as they came out of the Tsugaru straits, he would need the same knowledge of their intentions little over two days,—which at twelve knots is 576 miles,—before they cleared the straits; for the western exit is but 600 miles from Tsu-shima. As the way round the east side of Japan is so much the longer, there would be ample time to receive the needed information, and to

decide where to await the enemy. In short, Togo was quite able to grapple with the strategy of the conditions upon terms of equal speed; and it may be added even with speed inferior by two or three knots. By the choice of central position, insuring interior lines, and by adequate measures for receiving intelligence, he made himself master of the strategical situation independent of probable speeds. The tactical question is another matter, to be considered later.

Let us now examine the alternative course, actually adopted by Rojdestvensky. At 5 a. m., Togo at Masampho received by wireless telegraphy definite intelligence that the enemy were sighted, at a point designated 203 in the Japanse intelligence system, apparently steering for the eastern Tsu-shima channel. We do not know certainly where 203 is, but, since two hours later the Russians were again reported, definitely, as 25 miles northwest of Ukushima, and as their speed was twelve knots, we can calculate that at 5 a. m., they were 114 miles from the scene of action, 10 miles north of Okinoshima, chosen by Togo upon the basis of the information transmitted continuously by his scouts. Masampho is from 80 to 85 miles from the same selected point. By good scouting and intelligent choice of position, coupled doubtless, though not explicitly affirmed, with heavy boiler fires and all preparations for instant departure,[1] the Japanese could move on an interior line, shorter by thirty miles than that of the enemy. At nearly equal speeds of twelve knots, this gave the former two hours and a half to spare; while, for the Russians to overcome this disadvantage, they would require a superiority in speed of more than four knots, throughout the seven hours in which their opponents were covering their distance. Had the two equal speeds been fifteen knots, the advantage in time for the Japanese would have been two hours; they requiring 5 3-5 hours, their opponents 7 3-5. With this higher speed, the Russians, during the time taken by their opponents, would have needed to maintain a speed five knots greater than theirs, or twenty knots, to arrive coincidently with them. Now, when speeds between fifteen and twenty are reached, nautical readers do not need to be told that, to make increases of four or five knots per hour with the same displacement, guns must be thrown overboard; not in

[1] Togo's report reads: "The different sections of the fleet at once (5 A. M.) commenced their hostile operations along the lines respectively laid down for them in the pre-arranged plan."

the race on the water, but in the plans of the constructor. Fighting power must be sacrificed. In the light of such conditions what are we to think of trivial increases of speed, a quarter, or one knot, or even two knots of top speed, which is a very different thing from the working speed which naval operations will compel for the best aggregate results.

Togo thus, by good scouting and choice of position, secured beyond reasonable hazard his strategic object of bringing the Russian fleet to battle, irrespective of speeds. Certainly, his problem was much simplified by the Russians' difficulty in having but a single port of refit open to them. But the fair reply is that the two admirals, like all general officers, had to deal with the problem before them; and a glance at the map will show that, had Port Arthur remained Russian to the day of battle, *the fleet within being destroyed,* the existence of the two ports need have made little change in Togo's plans, a consideration which deepens the condemnation of those who could find for that fleet no better use than to sink it.

If superior speed can be shown to have had so little necessary effect upon the strategy of the campaign, how was it in the tactics of the battle. Owing to his sagacious choice of position, the Japanese admiral was able to appear directly across his antagonist's desired line of advance. He had headed him; not only in the usual sense of the word, but in acquiring intelligent knowledge and appreciation of the conditions before him. Any remarks on the tactics on the occasion would be incomplete, if mention were omitted of the advantage obtained by a thoroughly up-to-date system of scouting. I infer, from casual mention, that the field of sea over which the enemy would probably approach was divided into squares, to each of which a number was given. Of these, 203 was one. Wireless telegraphy speaks for itself. The system was better than that of a century ago, simply in so far as means have been developed; now, as then, antagonists may be on equal terms. It depends on themselves. There is no indication that Rojdestvensky knew anything certainly of his adversary's position, or dispositions, before the battleships came actually in sight. Togo, on the contrary, notwithstanding a haze contracting the horizon, " was able, before I could see the enemy with my own eyes, to know that the enemy's fighting sections comprised the whole of the second and third squadron; that they were accom-

panied by seven special service ships; that the enemy's ships were disposed in a double column formation; that their strength was placed at the head of the right column, with the special service ships at their rear; that the enemy's rate of speed was about twelve knots; that the enemy were continuing to steam in a northeasterly direction; and so forth." Any change that might occur from moment to moment would be equally transmitted. He was thus able to decide, not only the point at which he would fight, but his dispositions for action. The Russian may be said almost to have been taken by surprise. If he had available scouts with him, they should have been far enough in advance of the main body to preclude observation, by driving off the enemy's lookouts, so as at least to insure equality of time for intelligent preparations. Togo's outer scouts, the ones which sighted the Russians at 5 a. m., were over a hundred miles from Masampho. It is interesting to remember, and illustrate results as compared with a century ago, that the leaving Cadiz by the allied fleets before Trafalgar was known to Nelson, fifty miles at sea, two and a half hours after the operation began; a period perhaps shorter in relation to power of movement than the results of to-day.

To return to the question of speed as affecting the battle. Togo reported that, his fleet having assembled at noon ten miles north of Okino-shima, he first sighted the enemy at 1.45 p. m., a few miles to the south. Let us interpret "south" literally; due south. The assumption is permissible; for reference to the simple geometric construction given above will show that, with the Russians bearing anywhere between S. S. E. and S. S. W., Togo retained the shorter line of operations, granting merely equal speeds. The Russians, being by this hypothesis due south, and steering northeast, it is plain that should Togo steer east—which for battle he did—he took one perpendicular of a right angled triangle, leaving to his opponents the hypothenuse. The other angles being 45 degrees, the distance they must traverse to reach the point where the two courses intersected, was nearly one-half greater than his. If his speed were ten knots only, they must go fourteen, merely in order to arrive together; while with equal speeds, if he took thirty minutes, they would need forty-two. It will be noted, also, in virtue of these shorter times, that if Togo continued to the point of intersection, he would be directly ahead of the enemy,

and only their bow guns would bear; whence it follows that, since he bore from them 45° forward of the beam when they were due south, as he advanced he would bring them more and more behind, throwing most of their battery successively out of bearing. To this doubtless was due the Russians keeping away, even before they opened fire; many of their guns at first scarcely bore properly, and, should they continue, would not bear at all. Having in view the Russian object of reaching Vladivostok without fighting, escape from the dilemma was hopeless, on any terms of speed likely to be found between two battle fleets. This will be shown further on. Under the particular circumstances there were but two alternatives: a charge direct, in line abreast, upon the Japanese fleet, trusting to breaking through in a mêlée, and some of the faster vessels escaping; or else to accept a formal pitched battle, by keeping off to insure the full play of their batteries. This was what was done actually, though clumsily; for the double column, with which the Russians ill-advisedly went into action, could not quickly develop the full power of the broadsides. It is ill performing under fire manœuvres which should be accomplished before. This process of keeping off had of course to be continuous to preserve the bearing of the guns.

I have said there was no escape from the Russian dilemma. To get to Vladivostok without fighting was impossible under any probable conditions of speed in the battleships. If instead of heading off gradually, to keep the broadsides in play, the Russians had at once steered east, parallel to Togo, they would with equal speeds have achieved no advantage. To keep off farther, bringing him abaft the beam, would impose upon him the greater distances; but such a course would be but the beginning of running away, of a stern chase; and to realize its complete benefit their backs must be fairly turned on Vladivostok, in full retreat. Such a course would have been less acceptable to Togo; but the issue would have been to bring out a condition too often disregarded by even professional men, though all know it. Squadron speed is not an average; it is the speed of the slowest. Consequently, when one party runs away, there will be among the vessels of his antagonist some which possess more than the equal speeds we are assuming. These take up the chase, and by their greater swiftness bring to action the rear vessels of those in flight. The others must either turn back to support them, which brings on a general

action; or, using their own superior speed, escape, leaving a partial victory to the enemy. But if unable to fight before, much less will they be able after such losses.

To anticipate Togo, under the courses the two combatants were steering immediately before the action—east and northeast—the Russians required a speed greater by one-half. If he went ten knots they neeeded fifteen; if twelve, eighteen. No professional opinion on either side of the controversy, I presume, will say that such differences are anywhere, or by any one, considered. The gains in speed, achieved by successive increases of tonnage or of engine space, at the cost of greater expenditure to obtain size, or of fighting power to increase speed, are much smaller. Let us suppose that the Russians had a fleet-speed superiority of two knots. By steering a parallel course, should Togo permit that condition to continue, they would draw ahead at the rate of two miles an hour. In five hours this would be ten miles, during which, assuming twelve knots for the slower fleet speed, the faster will have run seventy, the distance of the nearest shore. It then has to turn north towards Vladivostock, with its slower opponent approaching to traverse its course by means of its faster vessels. It may be objected that the proximity of land, being particular to the instance before us, is foreign to the general discussion. The reply is that all safe generalization is based upon numerous instances, and this is one; but further, as a matter of general experience, it is quite as likely that the slower fleet will have some ships equalling or excelling the fleet speed of the faster, as that the fleet speed of that faster body will be two knots greater than its adversary's. In the particular instance, the Japanese did have the two or more knots superiority, due to the particular cause that, being in home waters, they had been recently docked. Had conditions of speed been against them, instead of favoring them, doubtless Togo would have modified both his strategy and his tactics. Now if Togo's actual superiority of two knots speed, due to the nearness of his home bases, gave him no determining superiority which he was not equally able to obtain, and did obtain, by good strategy, it may fairly be asked would it have been worth while for the Russians, at the time of meeting, to have had two knots greater fleet speed, purchased by the sacrifice of gun power; to achieve the mere result of running away, with such doubtful chance in their favor.

Before summarizing a conclusion, let us note one prominent feature of the battle of the Japan Sea, commonly to the partial engagement of the previous August 10, the bearing of which upon the question of speed seems to me to have engaged little attention. One of the frequent incidents of both actions is the damage to funnels, either complete destruction or large perforation, destroying or diminishing draught, and with it speed. If the battleships keep together, which as a rule they should, the fleet speed is reduced at once to that of the injured ship. This factor does not come into play in the movements which precede the action, but it may seriously affect conditions of flight and pursuit, as also the power conferred by superior engine development in subsequent operations by fleets distant from their means of repair. The loss of a modern funnel will be like the loss of a former-day lower mast. Certainly, no discussion of the utility of speed obtained at the sacrifice of gun power can be adequate, if it does not take full account of this specific result, which has also a further bearing. The funnels are open to serious injury by guns of that secondary battery, six to eight inch, which there is now a tendency to discard. It has long been my own opinion that the so-called secondary battery is really entitled to the name primary, because its effect is exerted mainly on the personnel, rather than the material of a vessel; and I am glad to find this view supported by the author of the article in Blackwood, though he does not use the same words. Whatever the improvements in quickness of handling 12-inch guns, it can scarcely be that, with an equal aggregate weight of broadsides, they can rival in volume of fire the much greater number and more rapidly discharged pieces of smaller calibre; and, when within the limits of useful perforation, volume of fire, multiplicity of projectiles, is better than individual weight of projectile, because it gives a greater number of hits. But under any useful construction of battleships there cannot fail to be important parts vulnerable to the smaller calibres.

There are other points of view from which the experiences of the Battle of the Japan Sea throw suggestive light upon the question of primary and secondary armaments—so-called; but it is best first to summarize conclusions in the subject of speed, with which we have been consecutively dealing. First of all, it must be remembered, and repeated, that no one maintains that increase of speed, even a quarter of a knot, is not a desirable thing; or

that greater speed, even to a small amount, is not of value, strategically and tactically. What is contended is that speed at its best is a less valuable factor in a battleship than fighting power, and that it is subject to more serious deductions, unavoidable and accidental, than fighting power is; and that for these reasons—original inferiority of value and greater uncertainty of maintenance—it must be kept severely in its proper place of subordination in the design of battleships. If we could assume a standard battleship,—and nothing condemns the assumption of an ideal, as useful to reasoning,—a ship in which fighting qualities, speed, coal endurance, and all the rest, were realized in perfect proportions, we would say that any increase of speed obtained by improved processes of engine-driving was a distinct advantage, but that the same increase, if obtained by sacrificing gun power to greater engine space was a disadvantage. Again, granting such a ship, we would say that to obtain increase of speed by increasing the size, whether the proportion of gun power be maintained or not,—though especially if not,—is also a mistake; for it means one of two things: fewer ships, or a larger national budget. Practically, the navies of the world have now committed themselves to solving their problem by progressive increases of size, which affects national expenditure in two principal ways: first, increase of cost by bigger ships, and, second, by prematurely relegating to the dump vessels good in themselves, but unable to keep up with the one last built. To-day's *Dreadnought* has no immunity from the common lot of all battleships. In a fleet, to-day, her speed will be that of her slower sisters; more *Dreadnoughts* must be built to keep up with her; and upon them in turn, according to the prevalent law of progress, she will be a drag, for her successors will excel her.

This wilful premature antiquating of good vessels is a growing and wanton evil. It is true, indeed, that this obsolescence is more in idea, in crude impression, than in fact. The vessels thus outstripped and outclassed remain immediately serviceable for places in the fleet, as well as for detached minor duties; but the inferiority to which they are successively dropped is different in kind from that of the old 74-gun ships, as contrasted with the three-decker. These were a permanent recognition of the fact, elicited by constant war experience, that a medium class of vessel was the best constituent unit for the composition of a fleet, which never-

theless could beneficially be strengthened at certain points by heavier batteries. Our present condition is that of abandoning all attempt at a guiding conception of types, or standards, except the crude one that each ship must be bigger than the last. The ultimate tendency of this, of course, will be to make ships after too short a time unequal to a place in the line. The moral effect is still worse, for it is inducing, in the navy as in the public, a simple trust in bigness, and, what is worse, an absence of trust in anything but bigness. Undoubtedly, if all other things—skill, courage, numbers, combinations, fortitude—are the same on both sides, bigness, barring accidents, will carry the day; but when have all other things been the same? We are putting in the foremost place of consideration that which military history shows to be the least of several factors. We have, indeed, the proverb, that "Providence is on the side of big battalions;" but we know it is not true. Napier is nearer the truth, in saying that the presence of Napoleon on a battle-field was equal to a reinforcement of 30,000 men. Providence is most often on the side of men who best know how to manage their battalions, or their ships; the smaller have more often triumphed by their conduct, than the bigger by their weight.

The perforation of funnels, with the diminution of speed, is but one illustration of the very serious effect which may be produced by the secondary batteries; that may be expected from them. In the present incipient, but well defined, purpose to dispense with these batteries, it is well to note at once the reversion to the *Monitor* type, which had a day, was abandoned, and now seeks to return. The single turreted monitor was for its limited uses effective; when it passed beyond those limits, of still waters, and posed as a sea-going battleship, it showed deficiencies which excluded it from such a function. The single turreted monitor was logical; it gave an all-round fire for a battery fully equal to the capabilities of its tonnage, and so concentrated in space that about it could be accumulated all the armor protection the tonnage could bear. Having a very low freeboard, one that also could be adequately armored; and as the vessel was intended for, and made its whole war record in, still waters, there was no rolling to expose the under water, unarmored hull. Further, the prescribed proportion between tonnage and battery weight being that compatible with all round fire of the latter, size

was restricted in the individual ship, and numbers increased. This facilitated dispersion of vessels around a single object, such as a shore battery, giving dispersion of guns with concentration of their fire; a disposition which is easily seen to combine the least exposure of one's own force with the greatest effect upon the opponent.

The advance to the two-turreted monitor was not logical; the increase of tonnage did not give all round fire to the increased battery; for a considerable arc of train each turret stood in the way of the other. One or more three turreted monitors were built in the United States towards the end of the Civil War, when the vogue of the monitor type probably reached its highest; but they saw no service. As turrets were added, and size increased, the vicious tendency became obvious. Exposure was concentrated, and dispersion of pieces was sacrificed. The concentration in each turret of so large a part of the whole battery gave a maximum of exposure, which necessitated elaborate protection for the turrets; and from this necessity defensive armor assumed a preponderance of consideration in the minds of officers and designers, entailing a predominance of the defensive over the offensive, which is also the note of long distance action. This is the precise opposite of Farragut's aphorism, that the best defence is our own rapid fire; that is, offence. Such a mental attitude is so contrary to the teachings of history that it should at once arouse inquiry. Nevertheless, the usefulness of the first monitors diverted attention from their limited sphere of action, which it was attempted to transfer to the deep sea. Not for the first time, nor yet for the last, men were assured that we had a revolution in naval warfare; not only implements, but principles, had been subverted. The prepossession in favor of heavy straight-ahead fire, to which the broadside was to be sacrificed, and the emphasis laid upon the ram, contributed powerfully to this conclusion. Those who kept touch with naval tactics of twenty or thirty years ago will remember the influence of these two ideas upon ship construction, and upon suggested fleet formations. Ingenious devices for increasing fire ahead were multiplied. A ship's side was broken into redans, and raised into stories for this object; while for battle purposes the line abreast almost superseded the line ahead. Both these dominant prepossessions have now disappeared. No attempt at ramming was made in the late

war; while in practice the broadside has reasserted the superiority inseparable from the fact that a vessel, being five to six times as long as she is broad, can always deploy a given weight of battery more effectively along her side than across her beam. The one exception to this is the small monitor—not the big.

Small, slow, clumsy to handle, but with the utmost battery it could carry concentrated in two pieces which were substantially one, and with all-round fire, the single turreted monitor was the gunboat of its day; the double turreted monitor was a degenerate from it. The *Inflexible* of the British Navy, launched, I think, in the seventies, marked the extreme and final development of this type. I have not references at hand, but as I remember she carried two turrets, each with two 16-inch guns; and many will remember the controversy as to the effect which injuries by gunfire to her hull, forward and abaft the armor belt, would exert upon her flotation. While admitting that a certain degree of perforation might cause her to upset, it was justly argued that the amount of such injury that could be effected was an artillery question; which I apprehend was equivalent to saying that hits from a battery like her own, of a very few large guns, were likely to be too few to admit the dangerous amount of water. From this followed directly that numerous pieces, unequal to her armor, but equal to piercing her unarmored extremities, might effect the desired injury, in whole or in part.

This conceded, there was cut out work for what are now called secondary batteries. For sea-going, the true monitor had proved hopelessly slow, and with any wave motion an extremely bad gun platform, owing less to the depth of the roll than to its excessive rapidity. Though demonstrated to be safe by several long voyages, notably one trans-atlantic, its general nautical qualities were poor. Low freeboard had to be abandoned, and the excessive metacentric height to be diminished in the interest of good aiming. There was thus induced a large superstructure, which since the *Inflexible* period has been utilized for the placing of the so-called secondary batteries, ranging from 4-inch to 8-inch guns, and above. Their number and rapidity of discharge constitute a great volume of fire, destined for targets such as the *Inflexible's* extremities—should such still exist—or other objects, such as the corresponding secondary batteries of an opponent. The question of adjustment between number of such pieces and the most

effective calibre for the individual gun is one of detail, quite apart from that of the principle that such a battery has its appropriate and important target in the enemy's vessel. If generally abandoned, that part of the mutual exposure disappears; but is there no other, not yet protected, perhaps not susceptible of protection?

In the Battle of the Japan Sea, the Japanese had in broadside 17 guns of primary battery; 16 of 12-inch and one of 10-inch; mostly, if not all, turret guns. It had also a total of 110 guns of secondary battery, in broadside. Of these totals, all the primary pieces and forty at least of the 6-inch guns were in Togo's own division, which began the action, received the first fire, and apparently endured the brunt and inflicted the greatest damage. In this division alone the lighter pieces were to the heavy in the proportion of 2½ to 1, and we may be justified in assuming that calibre for calibre there were at least four discharges of the secondary to one of the heavier, with the consequent probability of a proportionate number of hits. This estimate is the more to be accepted, because Kamimura's division, the armored cruisers, which carried nothing heavier than 8-inch guns, certainly brought their fifty-odd into the contest; for the *Asama* of this class was forced for a time to withdraw, in order to repair injuries from the Russian shells. The volume of Japanese fire then amounts to 17 primary and some 90 odd secondary guns. With what result? The *Oslyabya* was sunk, by gunfire; the *Souvaroff* lost by gun fire a mast and two funnels, a disablement which permitted her to be torpedoed, so far successfully as to incline her ten degrees; the *Alexander III* and *Borodino* were also sunk by gun fire, or in consequence of it, for both went down before the night torpedo attacks were made. The *Orel,* when brought into port, had the upper part of her forward funnel shot away, as also the muzzle of a 12-inch gun. We still need more definite and specific information, which in the case of the sunken vessels may never be had; but from the heeling of some, and the sinking of all, might naturally be inferred that shots penetrating near or below the water line were a principal contributory cause. We are told, however, that owing to the weight of stores, ammunition, and coal on board, the armored belts were submerged, and in consequence the hulls at the water line, and close above, were easily penetrable. I own to some perplexity as to how this should arise, from the reason specified, when so near the point of arrival, and so obvi-

ously improper with battle imminently probable. If such submersion existed, as the preponderance of evidence goes to show, it seems more likely due to a circumstance stated by Captain Klado, of the Russian navy, in his Battle of the Sea of Japan, advance sheets of which I have been permitted to see. He states that several armored vessels of that service were terribly overweighted, the displacement exceeding that intended, so that the belt of thickest armor did not rise two feet above the water. The displacement of the *Souvaroff* should have been 13,500 tons, whereas in fact it exceeded 15,000. Granting the fact of submersion, to whatever due, it nevertheless appears from the sea conditions of the battle that, under usual and proper conditions of submersion, rolling may frequently be so heavy as to expose continually unarmored bottoms, while yet not so extreme as to preclude decisive fleet action. Can the armor belt be continued to the extremities, bow and stern, of such thickness as to exclude secondary batteries, and at the same time of such depth as to provide against the exposure of the bottoms by rolling? and, if so, will the gain of defensive strength compensate for the weight thus deducted from offensive purposes? Against such a target, penetrable to all guns, volume of fire is of the utmost importance; for, while the aiming may be all of the best, the opportune moment of the shot's arrival, when the bottom is exposed, is beyond the control of the aptest gunner. In so far the effect is chance; and favorable chance increases with numbers or volume. Further, as stated by Sir William White in a recent lecture, the Russians declared they were blinded by the volume of shells from the Japanese guns. This result being upon the personnel, goes far to establish the actual superiority of the secondary battery, in which the Russians had little more than half the number possessed by the enemy; while in the heavier calibres they had more than double.

The disposition to revert to the monitor type by discarding secondary batteries is the composite result of two prepossessions: in favor of high speed and of distant action. The latter is to be enforced by the combination of superior speed with guns, the effective range of which is insured by great size; by heavy calibre. By my greater speed, be it but a fourth of a knot, I shall maintain a position where my adversary's secondary battery can do no harm, while my own primary, outnumbering his in the degree

obtained by sacrificing secondary guns, will destroy him. Superficially plausible, the argument is logically unimpeachable. The difficulty is that it disregards experience; not of its own proposition, indeed, for it has not been experimentally tried, but the experience of history. It is the old gunboat theory, in one of its several incarnations; for, if the essential principle of design remain, a gunboat is no less a gunboat because a hundred times as big. Given a small number of long range guns, take a position suitable by favorable range, and within the dead angle of the enemy's broadside, utilizing a calm or shoal waters; and behold the hostile frigate disabled and captured.

I do not think the parallelism of principle is here overstrained. The dominating considerations in the two arguments are identical, though it must be admitted that the qualifying factors are somewhat different and may affect the practical issue now. In the case of gunboats, always presumed to be provided with guns of the heaviest calibre, history has recorded its verdict. To-day the decision seems to turn upon the question whether the primary batteries, under all conditions which admit of fleets engaging, can make efficient practice at ranges which will prevent the secondary guns of the enemy from perforating the funnels or exposed bottoms. This analysis concedes superior speed to the fleet which has discarded secondaries; but it is needless to say that, unless the distance taken does insure the immunity of funnels, the fleet with the least volume of fire—without secondary batteries—is by all theory of probability the one most likely to lose speed by the fallen funnel of a single ship. It is to be observed, also, that the great distances proposed do away with the advantage of the flat trajectory—the point-blank of to-day—in which the heavier guns excel the lighter. Recourse must be had to elevation of guns, with which, against a target of horizontal extension, such as a ship's hull, errors of aim increase in accelerating ratio. All naval men know full well the "good line shot, but over," "or short;" a shot, in brief, that has missed its mark through vertical deviation. The grouped funnels, three or four in number, of the modern fast battleship, offer on the contrary a vertical target, one the least often missed by the average gunner, who usually shoots straight, but errs by too high or too low. In South Africa, I have heard that the Boer fire lost immensely in effectiveness, when instead of level they had to fire down hill. Of course, the

funnel development of two fleets may be assumed equal; but the question posed is the effect of volume of fire. Both, too, may be assumed equal in exposure of the underwater bodies; but inferior volume of fire carries with it increased probability of being oftenest hit.

But, if this estimate of probabilities be deceived, as chance may very well occasion, and the first ship to be disabled belong to the fleet with secondary batteries, what will the other fleet do? Close, for decisive action? It then sacrifices the very advantage supposed inherent in the longer range, heavier gun; for the ship thus disabled is by no means necessarily a ship lost to fighting, and the battery power of her fleet may have undergone no diminution. Her fleet too has every reason to wish to close; and therefore, in the contrary event of the first ship reduced as to speed being in the fleet that wishes long range, the opponent will close at once, and can close, because the hostile speed is reduced to that of the slowest ship. All this, which is irrefutable, goes to show that the fleet which has thus placed its dependence on long range fire has with it assumed the moral tone and temperament associated with the indisposition to close. An advantage gained cannot be improved, unless in itself quite decisive; a disadvantage which merely reduces its speed is, on the contrary, already a check, a moral as well as material defeat, which subjects it to the disaster of close action, less favorable to itself than to the opponent, the power of whose guns increases with approach. I do not wish to lay undue stress on moral forces, undeniable as is the effect of habitual action, or prepossession, upon moral strength; but I think appeal can be made confidently to history that the navy which, for any reason, habitually seeks to keep its enemy at a distance, in order to secure a preliminary advantage, usually fails to achieve more than a defensive successs for the occasion, and in the long run finds itself brought to battle at an unexpected moment, under conditions unfavorable to it, both materially and morally. "Close" undoubtedly is a relative term; but, however extended or contracted, it can scarcely at any period mean farther than nearly the point-blank range of a ship's principal battery.

Among the many factors—such as armor protection and coal endurance—which enter into the efficiency of a battleship, speed and offensive power—gun power—are at present the leading

competing considerations. The proper adjustment of all, allotting to each its exact proportion of the available tonnage, constitutes a problem of no small difficulty, and is not infrequently characterized as a compromise. One cannot easily recall all the loose expressions one may at various times have carelessly uttered, and it may be that I have myself used the word in this connection; but long ago I have adopted, as my view of military compromise, an absurd story I once heard of a dispute between man and wife where they should spend the summer. He said Newport; she Saratoga; they compromised on Saratoga. The adjustment between the two necessary qualities of offensive power and speed for battleships may be called a compromise; but it should always be on offensive power.

What do you mean by this vague definition? I mean, primarily, the cultivation of the mental attitude which keeps offensive power in the foreground; a steadfast prepossession in favor of its immortal superiority. I should say next, a studious consideration of how far differences of speed really matter strategically. Control of the sea being the leading object of naval war, and strategy being more conclusive than tactics, what probable advantage does a fleet obtain by arriving ten days sooner, if it must get behind batteries on coming of an opponent who has preferred offensive power to speed? Again, remembering that for a fleet the speed is that of the slowest, and taking into consideration the incidents of naval war service, is it not probable that there can be determined a very probable serviceable fleet-speed for navies, than which two knots more or less at a given moment will not greatly matter? That the Russian fleet, despite all disadvantage of heterogeneous units, of the long cruise, and protracted anchorages, without docking, was maintaining on May 27 a fleet-speed of at least twelve knots, while the Japanese seem not to have used more than fifteen, may afford some initial indications. No one is contending for no speed; but there are those who contend that speed is merely for bringing offensive power into play; that when it exceeds this, and expects to achieve success by running, it has small object, for the sea does not habitually, nor often, present positions at which by anticipating an enemy you achieve strategic effect. It sometimes does, but the rule is otherwise; and in the exceptional cases the observance of strategic considerations of position and interior lines will often, as in Togo's recent action,

accomplish quite as much as higher speed. In short, at sea, speed falls within the province of evading the enemy; offensive power within that of crushing him.

The question of primary and secondary batteries also is not one of compromise, except as defined above. The one or the other must have its superiority admitted, and the inferior be discarded or duly subordinated. As this question supposes the fleets in presence, it is tactical, not strategical. I have already advanced the arguments in the matter, and now will only draw attention to the fact that here again speed, being an essential feature of ships that are to abandon secondaries, entails, necessarily, and avowedly, evading, keeping at long range; a system which never has worked historically. In tactics also, as in strategy, superiority of speed may be more than compensated by dispositions on the ground, as I hope to have illustrated by the incidents off Tsu-shima. Just at present, however, speed is continuously being gained without apparent sacrifice of aggregate gun power, by the simple but ruinous procedure of increasing size indefinitely; had still more been gained by sacrificing gun power, as in the armored cruiser, there would have been increased necessity of evasion.

The ever increasing size and startling cost of the battleship brings us also face to face with the opposing considerations of numbers and reduction of expense. That the relative cost of the larger ship is less than that of the smaller, that expenditure increases at a smaller ratio than tonnage, as stated, only partially qualifies the fact of the absolute increase, and does not at all modify the ultimate effect upon the numbers of the fleet. Budgets not being illimitable in size, there results between numbers and individual cost of ship an opposition, in the adjustment of which, as in that between speed and offensive power, there should be no compromise. The superior claim of the one or the other should be admitted; and when admitted, enforced in practice. A nation with wide naval responsibilities must have numbers in proportion; and this consideration is greatly reinforced by another, advanced before this war and confirmed by it, that naval war henceforward will be marked by greater losses of material than of personnel; that reserves of ships will be more needed than reserves of men. The exigency of renewing coal supply works in the same direction. When not able to coal in the open, ships must be more frequently sent to the base to re-coal. This means a greater

number of ships in order to maintain a given minimum on the cruising station. The bigger and fewer the ships, the greater the proportionate loss when one goes into port.

In most matters of dispute a concrete illustration is worth many words, and in this matter of compromise we have such in the armored cruiser; a true compromise, if ever there was one. The very words "armored" and "cruiser" are in direct opposition, as one might say "heavy light cavalry." The type discards unity of design, and deliberately embraces a double purpose. A cruiser should be like a bird of prey, of strong wing and rapid flght, which seeks not equals, but inferiors. The cruiser, whether for scouting, or for commerce destruction, or the carriage of messages, needs swift and long continued motion; that is, speed and coal endurance. As these two qualities should in the battleship be—not ignored—but subordinated to fighting power, so in the cruiser gun power and armor are to be subordinated, and in the main discarded, so long as they interfere materially with the essential unity of design, to which speed and coal endurance both contribute. I am particularly glad to use this illustration; for it will serve better than any elaborate protest to show that opposition to the present breathless increase of speed in battleships proceeds not from any depreciation of speed as such, but from the conviction that in every class of naval vessel there should first of all, and first and last, throughout her design, be the recognition of her purpose in war. All other necessary qualities should be regarded as merely ministering to this one purpose, which in battleships is offensive power exerted in fleets, and in cruisers long continued speed, in vessels meant to act for the most part singly. As to numbers of cruisers, no fleet ever yet had enough of them, to scatter wherever needed.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

EARLIEST ENGLISH NAVIGATION, AND FIRST SCHOOLS OF WARFARE.

By THOS. G. FORD.

Tis the bold race
Laughing at toil, and gay in danger's face,
Who quit with joy, when fame and glory lead,
Their richest pasture and their greenest mead,
The perils of the stormy deep to dare,
And jocund own their dearest pleasures there.
One common zeal the manly race inspires,
One common cause each ardent bosom fires,
From the bold youth whose agile limbs ascend
The giddy mast when angry winds contend,
And while the yard dips low its pointed arm,
Clings to the cord, and sings amidst the storm,
To the experienced Chief who knows to guide
The laboring vessel thro' the rolling tide;
Or when contending squadrons fierce engage,
Direct the battle's thunder where to rage:
All, all alike with cool unfeigned delight
Brave the tempestuous gale and court the fight.
—*Henry James Pye's "Naucratia"* (1798).

In the previous narrative of the early development of nautical art, science, and education, we purposely made no mention of contemporaneous English efforts in the same direction. These are more interesting to us who are descended from that great naval power, with an inheritance of nautical skill and commercial instinct that made us in little over half a century from the date of Independence her most formidable rival on the sea. They are also comprehensive enough to be treated in a separate chapter, embracing the period from the first quarter of the sixteenth century, when England began to interest herself in this great naval

movement of the age and the organization of her naval service as a distinct profession, until the subject of naval training and education was taken up on this side of the Atlantic. In a preliminary way, however, it may be appropriate to give a few facts relating to the mixed condition of naval service in England previous to its unification, which are gleaned from the delightful old "Naval Tracts" of Admiral Sir William Monson,[1] written during his retirement at his seat at Kinnersley in Surrey, in the early part of the seventeenth century, "for the delectation of his friends," and from interesting lectures delivered by J. K. Laughton, Professor of Naval History at the Royal Naval College, Greenwich.

Before any ship employed in the King's service was armed as an engine of war, the captain was a soldier, bearing on his lance a single-tailed pennon, which afterwards was lengthened into the regulation pennant of a naval captain. Next above him in rank was the knight, exercising command afloat or ashore, from whose lance floated a swallow-tailed pennon, afterwards the well-known broad-pennant of a commodore; while the highest officer, the knight-banneret, was privileged to wear the square flag which in time became the distinguishing flag of an admiral. The other officers on the King's ships were also soldiers, put in command of the fighting men. But the master—the important possessor of the secrets of navigation—was necessarily a seaman. He was the guide upon whom every soul in the ship depended for safe conveyance from port to port; but his pay of six-pence a day, even in time of war, indicates the low estimate in which his office was then held. In time of peace, he commanded the ship as a merchantman, and, rough tarpaulin that he was, had no ambition of any sort beyond her bulwarks. The pilot's office in Monson's time was confined chiefly to the charge of a ship on entering or leaving a port, and of the relative importance of master and pilot, the doughty English admiral says: "The

[1] Sir William Monson's "Naval Tracts" in six books, from the original manuscript at London in 1703, in J. A. Churchill's collection of voyages, with a history of navigation, London, 1732. Monson was born in 1569—died in 1642. He ran away from home in his boyhood to join a privateer as a common sailor, after which rough service he entered the British Navy as a volunteer, and in one step was made a captain in his eighteenth year—partly by family influence. In due time he became an admiral of great distinction.

Pilot's charge is of greater weight than the office of Master; for by reason of our daily experience in long voyages the conduction of a ship is of little difficulty, for it has not been heard that any ship ever went out of England and returned home again without finding the country or place she went for."

It is a singular fact that when these pages were written, years ago, among a very large collection of old works relating to naval history at Annapolis, it is only in a French[2] work that a good specimen of the earliest English sea-language could be found. It is in the form of a quaint sailor song so-called, of Edward the Third's time, describing rather solemnly the getting under way of a pilgrim-ship bound to the Holy Land. The first two verses of the song express the melancholy regrets of the sailors at the necessity of going to sea, which is accounted for by the many drawbacks attending the carrying of pilgrims to Palestine, and by the wretched condition of the English merchant's service of that period. The succeeding verses, as written in old English, are as follows:

Anone the mastyr commandeth fast
To hys shyp-men, in all the hast
To dresse hem sone about the mast
Their takeling to make.

With "howe, hissa," then they cry
Wat howe mate, thou stondyst to ny
Thy fellow may nat hale the by;
Thus they begyn to crake.

A boy of tweyn anone up styen
And overt-whart the sayle-yerde lyen,
"Y how talya!" the remenaunt cryen
And pull with all thyr myght

Bestowe the bote, bote-swayne, anon,
That our pylgryms may pley thereon,
For som ar lyke to cowgh or grone
Or hit be ful mydnyght.

[2] In volume 2, page 550, of his "Archeologie Navale," Jal gives this so-called song from a copy in his possession, received from Thomas Wright, correspondent at London of the Committee on Charts and Inscriptions. It was found originally in a manuscript of the reign of Henry VI, but it had neither title nor date. It is supposed to belong to the time of Richard II or Edward III.

Hale the bowelyne! now, vere the shete!
Coke, make redy anoon our mete,
Our pylgryms have no lust to ete
I pray God yeve hem rest.

Go to the helm; what howe! no nere!
Steward, felow, a pot of bere!
Ye shall have, ser, with good chere
Anone, all of the best.

Y, howe, trussa; hale in the brayles!
Thou halyst nat; be god! thou fayles.
O se howe well owre good shyp sayles!
And thus they say among.

Hale in the wartake! hit shal be done,
Steward, cover the boorde anone,
And set bred and salt thereone;
And tary nat to long.

Then cometh oone and scyth, be mery,
Ye shall have a storme or a pery.
Holde thow thy pese! thow canst no whery;
Thow medlyst wondyr sore.

Thys mene cohyle the pylgryms ly
And have theyr bowlys fast theym by,
And cry aftyr hofe malvesy
Thow helpe for to restore!

And som wold have a saltyd tost,
Ifor they might ete neyther sode ne rost;
A man myght sone pay for theyr cost,
As for oo day or tway ne.

Som layde theyr bookys on theyr kne,
Andrad so long they myght nat se;
Alas! myne hede woll cleve on thre,
Thus seyth another certayne.

Then cometh owre owner lyke a lorde,
And speketh many a royall worde
And dressed hym to the hygh borde,
To see all thyng be well.

Anone he calleth a carpentere,
And byddyth hym bryng with hym hys gere,
To make the cabans here and there,
With many a febyll cell.

A sak of straw were there ryght good,
Ifor some must lyg theym ni theyr hood;
I had as lefe be in the wood
Without mete or drynk.

For when that we shall go to bedde,
The pumpe was nygh our bedde hede;
A man were as good to be dede,
And smell thereof the stynk.

This is thought to be the oldest English sailor song that has come down to us.[1] It is evidently written by a rough sea-poet familiar with the strange nautical jargon of that day, but it has more of the character of a descriptive sea poem than of a sailor song. Even if ever sung, it could not have helped Jack to heave up the anchor, or hoist the topsails, as did the spirited capstan-ditties of a later date. Nor could it have enlivened his traditional Saturday night at sea, like Dibdin's immortal lyrics. But it reveals at a very early period the existence of the same swearing, drinking skipper still found in the merchant service. Sailors swore so lustily in the Middle Ages that the laws of Alençon prescribed the punishment of cutting out the tongue of him who offended for the second time. The Norman code directed the head of a blasphemous sailor to be shaved, and earlier laws required him to run the gauntlet or have his ears cut off. Venice in the fourteenth century branded such offenders. Jal tells us that Moncenigo punished with flogging every man guilty of blasphemy, and inflicted a penalty of 100 sous on any sailor of the poop, any statesman, officer, or gentleman, guilty of the like offence. Columbus, the cleanest of men morally and mentally, but a sailor to the backbone, never tolerated swearing. The English, as early as the thirteenth century, punished blasphemers with keel-hauling, and in Queen Elizabeth's time some inhuman devices were employed to curb the blackguard unruly spirit of the sailor. It was not an uncommon thing in the fleet to see an able-bodied seaman tied up in a bag hung at the bowsprit end, he being supplied with a biscuit, a bottle of beer, and a sharp

[1] Of somewhat later date, after Shakespeare's time, is the very old English sailor song "We be Three Mariners," which has more of the ring and language of the Dibdin School of nautical songsters.

knife, so that when weary of the situation he could put an end to his life. Another unfortunate might have been seen suspended from the yard-arm by the heels, and bumping against the side of the ship every time she rolled. Five hundred lashes were often given to riotous sailors, producing no better effect than 4 dozen inflicted in our day. Doubtless, too, the rough masters of the pilgrim ships in Edward the Third's time had greater provocation to nautical vices than the more polished captains of emigrant ships in our day, and it might be said also, with some truth, that they were better all-around sailors. But the time came at last when the ship herself was converted into an engine of war by arming her with guns, and it was found necessary, in time of war, to put a seaman instead of a soldier in command of her, or to select for that post such a sea-soldier and mariner combined, as is described by Monson, "who knows how to manage a ship and maintain a sea fight judicially, for defence of himself and offence of his enemy." The change was necessary also to enable the captain to exercise proper control over the sometimes presuming master. There were commanders of this type in Queen Elizabeth's fleet, as well as genuine old salts such as Drake, "a master in every branch of navigation, especially in Astronomy and in the application thereof to the art of sailing;" Hawkins and Frobisher, who had nothing of the soldier in them; but no distinction was made, says Schomberg, between the Earl of Essex, the general, and the Lord Thomas Howard, the admiral, in that warlike reign.

It was in the latter part of this reign that the inferior office of lieutenant was created, for the training of young gentlemen destined for command. But when appointed, the lieutenant was merely a landsman, a volunteer from the shore, "to learn what seamanship he could to assist the Captain in command of the men, especially in action, but not to interfere in the navigation of the ship, which remained in the hands of the Master." "The Lieutenant must have a care that he carry not himself proudly or presumptuously, nor that his Captain give him power or authority to intermeddle with the Master's office; for where there is heart-burning between the Lieutenant and Master, it will make it burst out into open discontent, and then will follow Mischief and Factions among the Company." The six things requisite in a master were "The Card, the Compass, the Tides, the Time, the

Wind, and the Ship's Way," and it is not to be wondered at that so important an officer resented—aye swore lustily at being put under an amateurish lieutenant who, perhaps, did not know the points of the compass. The innovation was not welcome even to Jack, who felt that the tarpaulin master understood him better than the priggish land-lubber, dubbed a lieutenant. Jack would submit with a volley of oaths to be put in the billbows, ducked at the yard-arm, flogged at the capstan or even keel-hauled provided the punishment were ordered by a salt like himself; but he thought it a humiliation to be punished by a young coxcomb who couldn't even talk the lingo of the sea—that strange language "not soon learned, much less understood, being only proper to him that has served his apprenticeship." Moreover, says Monson, "a boisterous sea and stormy weather will make a man not bred on it so sick, that it bereaves him of Legs, Stomach and Courage, so much as to fight with his meat. And in such weather, when he hears the Seaman cry Starboard or Port, or to bide Aloof, or flat a sheet, or haul home a cluling, he thinks he hears a barbarous speech which he conceives not the meaning of." The newly-made, seasick lieutenant, therefore, ignorant of the language and manners of the sea, could exercise no control over the stubborn sailor. But in the year 1620, the lieutenant was created for divers other reasons, with the hope that in time he would make himself felt in the service. "A Lieutenant," says the gallant Monson, writing in that year, "is an employment for a gentleman well-bred, who knows how to entertain Ambassadors, gentlemen and strangers when they come aboard, either in presence or absence of a Captain. A Lieutenant is to be sent on a message either aboard ships or ashore, upon any occasion of service, though it be to great persons—an unfit employment for a Master. A Lieutenant knows how to use gentlemen and soldiers with more courtesy and friendly behavior, and will give better satisfaction than any other mariner or master can do who have not been bred to it but in the rude manner of a mariner." From the beginning, therefore, the lieutenant was recognized as an officer and a gentleman, whose social advantages often hastened his professional advancement. In time, it was from the corps of lieutenants of all navies that were evolved the brilliant naval Chesterfields and swells who were charged with the conduct of nautical feasts and ceremonies afloat, and it must be added that,

like the dandies of the army, they were oftentimes the best fighters in the hour of battle. But their time for professional glory was yet to come. There was no distinct naval profession during the reign of James I (1603-25), and for want of the Spanish system of nautical training (says Doyle) England's efforts at sea were frustrated. But great interest was then taken in England in naval affairs. This interest was doubtless stimulated by two very able discourses written by Sir Walter Raleigh, "whose reading made him skilled in all the seas," on the "Invention of Shipping," and on the "Royal Navy and Sea Service"—the earliest treatises upon these subjects. The King himself was given to scientific investigation, and made a special study of naval architecture, with the view of improving the build of his ships. In this work he was aided by Phineas Pett, a Cambridge University scholar and mathematician, who soon became the first scientific naval architect of England. In 1606, Pett was elected First Master of the Shipwright's Company. He was the master builder at Chatham dockyard with the title of captain, and there he launched, in 1610, the *Prince Royal* of 1400 tons—a noble vessel of war embodying the new ideas of the time. All the cumbrous top-hamper that previously disfigured vessels of this class, was swept away by this bold young architect, to whom is due also the credit of many other radical reforms in naval construction. Another member of the Pett family, in the reign of Charles II, first introduced separate cabins for officers on board of armed vessels. Still another Pett, in the succeeding reign, tried the experiment of sheathing men-of-war with lead as a protection against artillery. Indeed, during a period of nearly 200 years, down to the end of the reign of William III, this family furnished a succession of architects for the Royal Navy, their plans and methods being transmitted from one to another with the profound secrecy then jealously maintained in the profession to which they belonged.

It was in the reign of James I also, that the British claim to the hereditary and uninterrupted right to the sovereignty of the seas, conveyed to them from their ancestors, as Monson states, "in trust for their latest posterity," was insisted upon with the greatest tenacity. Although won by the combined efforts of sailors and soldiers serving afloat, the maintenance of this sov-

ereignty was now mainly committed to the old salts so-called, who knew how to enforce it with peculiar acerbity.[4]

"England truly challenges the prerogative of wearing the Flag as the Sole Commander of our Seas," says Monson, "and so has held it, without contradiction, time out of mind. If a fleet of any country shall pass upon His Majesty's Seas, they are to acknowledge a sovereignty to His Majesty by coming under the lee of the Admiral, by striking their Top-sails and taking in their Flag." Moreover, when Admiral Monson anchored his fleet in the Downs in 1603, he was not satisfied with the triple striking of the flags of the Dutch squadron lying there, but required the enraged Dutchman in command to keep them struck during his entire cruise on the English coast. We can well imagine the depth of this humiliation for the brave Hollanders, who had fought many a good fight with the English, and were fighting the encroachments of the sea itself to preserve existence as a nation. They could "repel the sea, dry the lakes, and imprison the rivers at home,[5] but they had to humble themselves to the bold British seamen." Nor were the haughty Spaniards, even in their best days as a naval power, permitted to sail the seas unchallenged. Schomberg tells us that the Lord High Admiral Howard, cruising in the English Channel, compelled the whole Spanish fleet of 160 sail (escorting King Philip on his way to England to espouse Queen Mary) to strike their colors and lower their topsails in homage to the British flag. These were, indeed, glorious days for the veteran seamen captains of Monson's type, who looked down upon the soldier captains still employed in the naval service, and heeded not the wordy contest waged by Grotius, in his "Mare Liberum" (1629), in opposition to the claim of British supremacy, and by Selden, in his "Mare Clausum," in defence thereof. But it gratified those haughty sea-kings to know that a copy of Selden's book was deposited in the Court of Admiralty by order of Charles I, there to remain "as a just

[4] An interesting document in metrical verse, entitled "The Dominion of the Sea," advocating the wisdom and necessity of England's control thereof, was written in Henry V's reign, just before the Parliament of England first formally claimed dominion of the narrow sea in 1416. Hakluyt gives this singular poem, which contains also an allusion to the Mariner's Compass, or "Shipman's Card," as it was called, then doubtless in general use on board of English ships.

[5] De Amicis "Holland."

evidence of our dominion of the Sea." It appears, however, that during the Commonwealth, the old salts in command were mistrusted by the Long Parliament, which once more put soldiers such as Blake, Monk, and Popham in command of the fleet. Seamanship, however, did not deteriorate, as these remarkable men acquired great nautical skill; and the inferior commands were left in charge of the younger seamen. Upon the accession of Charles II to the throne, his brother, the Duke of York, was appointed to an active command at sea, which made the service fashionable among the young nobles at court. Many of these, utterly ignorant of the seaman's art, obtained from the too pliant monarch a captain's commission with the command of a ship of war. "It mattered not," says Macaulay,[8] "that he had never in his life taken a voyage except on the Thames, that he could not keep his fleet in a breeze, that he did knot know the difference between latitude and longitude. No previous training was thought necessary, or, at most, he was sent to make a short trip in a man-of-war, where he was subjected to no discipline; where he was treated with marked respect, and where he lived in a round of revels and amusements." Such were the gentlemen-captains of this period, who, says the Naval Secretary Pepys, "depending on the interest of their friends at Court, will venture to do what a plain tarpaulin, if he had no other reason, would never dare." They were autocrats, too, of the most extreme type, keeping their lieutenants at an humble distance. And the lieutenants, whose highest pay until 1700 was only five shillings a day, lorded it in turn over master, purser, surgeon, and chaplain—then not regarded as officers,—even to the point of enforcing an order with an oath or a blow.

> Ne'er from the lap of luxury and ease
> Shall spring the hardy warrior of the seas—
> A toilsome youth the mariner must form
> Nurs'd on the wave, and cradled in the storm.
> —*Pye's Naucratia.*

In due time the Duke of York became Lord High Admiral of England, and filled the office most worthily. His previous experience at sea, coupled with the wise counsel of his secretary, the invaluable Pepys, "the greatest and most useful minister that ever filled the same situation in England," brought forth the

[8] "History of England," Reign of Charles II.

famous "Sailing and Fighting Instructions for His Majesty's Fleet."[1]

The effect of this stringent body of regulations was seen five years later when the Prince—"the Light and Guide of all the rest"—won a brilliant victory over the Dutch fleet commanded by Opdam and Van Tromp. In this engagement several of the so-called gentlemen-captains, pilloried by Macaulay, were knocked about by the Dutch cannon balls, which must have given them a distaste for the service. But the brave tarpaulin captains were in their true element on these occasions, and fortunately for the honor of England there was a succession of them in her navy at that time, such as Admiral John Benbow, Sir Christopher Myng, once a cabin boy, and his cabin boy, afterwards Sir John Narborough, whose cabin boy Shovel swam through the line of an enemy's fire, carrying dispatches in his mouth to a distant ship, for which exploit he was made a midshipman, and afterwards became Admiral Sir Cloudesly Shovel. This probably is the only such case in naval history.[2]

[1] A very fine edition of these "Instructions," dated on board the *Cumberland* at the Nore, May 18, 1716, and adorned on the margin of each page with colored hand-illustrations of ships in every possible position of sailing, is found in the library of Naval Academy.

[2] W. Laird Clowes writing in the *London Times* of January 22, 1891, on the subject of promotion from the ranks in the Navy, speaks of Messrs. Narborough and Shovel, who are said by Macaulay to have entered the service as cabin-boys. Narborough came from an old family in Norfolk; Shovel, who married Narborough's widow, came of good family, although Campbell says he was apprenticed to a shoemaker. But little is known of the youth of these officers. In much later days Thomas Barnes Cochrane, Earl of Dundonald, entered service as captain's servant on board the *Vesuvius*. Nelson entered service in a somewhat similar capacity. Sir Charles Ogle, Sir George Cockburn, and Sir W. T. Lake, were all captain's servants. Sir T. B. Martin was actually rated as captain's servant on the *Pegasus*, after having studied in the Royal Naval Academy. Honorable Sir John Talbot entered in the *Boreas* as Nelson's servant. Lord Waldegram entered as first-class boy. But all this means only that captains being allowed, until after the beginning of this century, to fill up their ship's company as they pleased, were willing to oblige friends by taking their sons with them as nominal, but bona fide, foremast hands or servants, until such time as they could be rated as midshipmen. The same kind of loose practice prevailed at the end of the seventeenth century. Bona fide foremast hands did occasionally reach the quarterdeck; they do now. But the advancement was and is wholly exceptional. At this time (1891), there were only two lieutenants in the entire roll of the active list of the British Navy who had been real foremast hands.

These famous flag-officers are known in naval history as the "Three Cock Thorpe Admirals," having been born in three hovels of the obscure hamlet of that name, near the village of Burnham Thorpe, which was also the birthplace of Nelson.[9]

Of the three, only Shovel[10] received the honors of burial in Westminster Abbey, and it will hardly be believed that he is represented on his tomb "by the figure of an insipid beau, dressed in a long periwig, and reposing upon velvet cushions under a canopy of state." Surely even a blundering artist might have refused to perpetuate such an absurd, unfit memorial of a great sailor. In the service, however, these men were remembered only in the guise and manner of doughty self-made admirals. To seamen of this type the fighting instructions of 1660 were most welcome on account of their disciplinary effect, which was increased by the later permanent establishment of the first navy board under the Great Seal of Charles II, together with other measures—all looking to the organization of the naval service as a distinct profession. But this was not fully accomplished until James II ascended the throne in 1685. His long experience as Lord High Admiral convinced him of the necessity of a new special commission which was appointed "for settling all things relating to the naval service, and for putting the management thereof into such a method as might need few or no alterations in succeeding times." While this commission was in authority, the King, aided by the ever faithful Pepys, issued a new set of instructions to the officers commanding his ships-of-war, dated July 15, 1686, which were allowed by all seamen "to be as judicious and effectual, and at the same time as gentle and practicable as can be desired." Moreover King James's knowledge of naval architecture, combined with the professional skill of Sir Anthony Deane, a member of the "Special Commission" aforesaid, the

[9] It is quite noticeable that Sir Francis Drake, Nelson, Berry, Hood, and other remarkable men of war were sons of clergymen.

[10] With Admiral Shovel in Queen Anne's reign was associated as a co-admiral, the soldier Earl of Peterborough, this being the last instance on record of the joint appointment of land and sea officers to the command of English fleets. Shovel married the widow of his patron, Narborough, and appointed her son on his staff, and both were drowned on the terrible night of October 22, 1707, when Shovel's squadron was wrecked on the Scilly rocks.

best naval architect of his day, produced such a fleet as had never before sailed under the British flag. Deane, like his predecessor, Phineas Pett, modelled the new ships after some captured French men-of-war, then considered the best afloat, although once contemptuously styled by the English "Bundles of laths."

It was therefore in the reign of the sailor King James II (1685-88), acknowledged to be the most learned monarch of his day, that the naval service of England really became a distinct profession in its organization and administration. It is supposed also that the humble grade of midshipman was created about this time, but as yet the most painstaking inquirer has been unable to fix the exact date, by any document or order, of the warrant aforesaid. Certain it is, however, that the question of naval education was not even mooted by the government or admiralty during the rule of the Stuart dynasty.

While the French government was bestowing great care upon the theoretical and practical training of its naval "aspirants," the British midshipman was left to his own resources, without the aid even of a nautical primer to guide his first steps in the profession. No provision was made for his instruction except in so far as the boatswain was capable of teaching him the ropes. A similar course had been adopted by that other whilom champion of the seas, Holland, which is accounted for by a veteran officer[a] of the French navy in the following singular manner: "It is probable that the propensity of the northern nations to meditate profoundly upon subjects to which they attach importance has made their governments apprehensive that if naval officers were required to study abstract science, its attractions might cause them to neglect their practical cunning, and become mathematicians instead of seamen. Such an unlooked for result would be impossible in the case of a versatile Frenchman, but quite probable in the case of a phlegmatic Englishman." If these were the sentiments of French naval officers generally, they utterly failed to comprehend the maritime spirit of their rivals across the Channel. It was conquest, not scientific culture of a professional sort, that occupied the minds of British seamen, and so long as victories afloat were won by rough and ready tarpaulin

[a] Du Bourg—"Essais sur la Marine de France de 1661 a 1789."

captains of the Shovel and Benbow [12] type, the question of theoretical instruction did not seem to be of pressing importance.

But it must not be supposed that nautical science was neglected in England while her naval heroes were making naval history. On the contrary, we find in various works treating of the seaman's art, ample evidence of the interest taken in this subject by Englishmen not connected with the marine, as well as by those who followed the sea professionally, and by the government itself.

> Of all who have since us'd the open sea,
> Than the bold English none more fame have won:
> Beyond the year, and out of heaven's high way,
> They make discoveries where they see no sun.
> —*Dryden's "Annus Mirabiles,"* 1666.

In 1573, only thirty-six years after the appearance of the earliest Portuguese treatise on the art of navigation, William Bourne published "A Regiment of the Sea, containing most profitable rules, mathematical experiences, and perfect knowledge of navigation." In this first navigation book written by an Englishman, and intended as a supplement to the Spanish work of Cortes already noticed, Bourne pointed out divers ways of finding the variation of the compass, exposed the errors of the plane chart, and advised mariners in sailing towards high latitudes, to keep the reckoning by the globe, as there the plane chart was most likely to lead them into trouble. He also published almanacs, with tables of declination. In 1578, Bourne published his "Inventions and Devices, very necessary for all generalles and Captaines or leaders of men, as well by sea as by land." This original book of 99 pages treated of not less than one hundred and thirteen subjects, the twenty-first of which gives the earliest known account of a log and line, and the principle of using them, as practiced by some navigators of his day to determine the speed of their vessels. Burnaby affirms in his "Ancient Geography" that no writer has preserved any account of the mode in which ancient navigators computed distances at sea. Yet the weight of testimony seems to confirm the statement of Samuel Purchas in his "Relations of the World, &c.," (1626) that the log was first used in 1607, the inventor thereof being unknown to this day. Nor

[12] Vice-Admiral John Benbow was born about 1650, went to sea very young in the Merchants' Service and acquired great skill in navigation, was appointed in the Navy afterwards, in which he rose to the highest rank.

was it generally used for a long time subsequent to that date, seamen being at variance not only as to the proper length of a log-line but also as to the length of a mile. Following closely after Bourne's interesting works, came the "Discovery of the dip of the Needle (1576)," by Robert Norman, a nautical instrument maker at Ratcliff. The pamphlet describing his invention was published in 1581 under the title "New Attractive, containing a short Discourse of the Magnet or Loadstone, and among other his vertues of a new discovered secret and subtil propertie concerning the declining of the needle touche, and therewith under the plain of the horizon; now first found out by Robert Norman, Hydrographer." To which was subjoined William Burroughs' "Discourse of the Variation of the Compass." Norman improved the compass, and maintained, in opposition to Cortes, that the variation was caused by some point on the surface of the earth and not in the heavens.

A great admirer of the "New Attractive" was Blundeville, who advised all mariners to read this treatise most diligently "so truly are the secrets of the loadstone, and the variation of the compass deciphered." He also expressed his concurrence in Norman's belief that "the properties of the Stone, as well in drawing Steel as in showing the North Pole are secret virtues given of God to that stone for man's necessary use and behoof, of which secret virtues no man is able to show the true cause."[11]

In 1585, John Blagrave, besides his "Mathematicall Jewell," wrote other books on navigation and mathematics. In 1586, Richard Polter published what Markham describes as a silly book, "The Pathway to Perfect Sailing," in which he held that different loadstones communicated different degrees of variation to the magnetic needle. In 1587 appeared a rare tract containing the best description of the sea astrolabe then known, the title of which read as follows: "A Mirror of Mathematicians; a Golden Gun for Geometricians; a Sure Safety for Saylers, and an Ancient Antiquary for Astronomers and Astrologians, by Robert Tanner, Gent., Practitioner in Astrologie and Physic, &c." He quaintly styled the astrolabe of his day "the traveller's joy and felicitie,"

[11] Norman affirms that the best loadstones in his time came from China and Bengal, were of the color of iron, and were sold for their weight in silver. The red stone of Arabia was the next in estimation.

and demonstrated its great utility by the recital of thirty-two distinct operations performed with it. "We here see," says this enthusiast, "that our forefathers had invented and constructed a very clever and useful instrument, and one which was remarkably portable, and there is probably no one instrument of modern times by which so many operations could be performed, and so much knowledge acquired." In the great year of the Spanish defeat (1588) Sr. Thomas Hood, an expert maker of compasses, constructed on the Norman principle, delivered a course of lectures on navigation, which were doubtless well attended by young mariners of that day. Hood also wrote several books on geometry, the cross-staff, globes, and charts.

In 1594, Captain John Davis, the Arctic navigator, "a most learned mariner and a good mathematician, as well as the first practical seaman of his day," published his "Seaman's Secrets." This was a very popular work, of which eight editions were published in half a century, entirely replacing the translations of Cortes; and in the following year he published the "Worldes Hydrographical Description," both of which books were eagerly read by mariners. This was just six years after the defeat of the Spanish Armada, an event which stimulated both seamen and scientists throughout England to develop the great art of navigation. It made every British seaman feel his superiority on the sea, and led bluff Captain Davis to boast in the preface of his book that "as navigators and seamen, we are not to be matched by any nation of the earth," which was quite true. More modest than he, however, were Sir Walter Raleigh and the Gilberts, his contemporaries and friends, who did splendid work in navigation and the art of war. The "Seaman's Secrets" was designed to be a practical handbook for the sailor, giving him also as much scientific information as was necessary for the proper understanding of the art of navigation. And Davis indicates the proper equipment of a navigator as follows: "The instruments necessary for a skillful seaman are a Sea Compasse, a Crossestaffe, a Quadrant, an Astrolobe, a Chart, an instrument magneticall (an azimuth compass) for the finding of the variation of the Compasse, an Horizontale plaine Sphere, a Globe, and a paradoxall Compasse, by which instruments all conclusions and infallible demonstrations Hidrographicall, Geographicall, and Cosmographicall, are without controlement of errour to be performed;

but the Sea Compass, Chart, and Crossestaffe are instruments sufficient for the Seaman's use, the Astrolabie and Quadrant being instruments very uncertaine for Sea observations." (Very interesting cuts of these instruments are to be found in John Davis's book, printed in Vol. 59.1 of Hakluyt Society publications).

It was Davis himself who had improved the cross-staff, or fore-staff,—so called because the observer in using it turned his face towards the object—by what was practically a new invention (1590) which he called the back-staff, used for taking the sun's altitude at sea, the observer's back being turned towards the object. Of this handy instrument, which superseded the clumsy astrolabe for taking meridian altitudes at sea, and which was commonly called Davis's quadrant, he says enthusiastically, "the Seaman shall not find any so good, and in all clymates of so great certaintie." It was afterwards improved by Flamstead with glass lens, and by Halley, and continued to be almost the only instrument used for taking altitudes of celestial bodies at sea until 1731, when it was entirely superseded by Hadley's quadrant, "which became as indispensable in navigation as the Mariner's Compass."

Davis, on his return from his Arctic voyage (1587), made a large scale map of the known world, which no longer exists, but his geographical discoveries are shown on the Molyneux globe. "His instructions," says Markham, "about great circle sailing, and his system of using a terrestrial globe fitted with a quadrant of altitude, might even now be studied with profit."

Contemporary with Captain Davis, was the quaint, delightful Maister Blundeville, who, in 1594, gave to the nautical world "His Exercises,"[4] containing six Treatises, which are very necessary to be read and learned of all young Gentlemen that have not been exercised in such disciplines, and yet are desirous to have knowledge as well as Cosmographie, Astronomie, and Geographie, as also in the Arte of Navigation, in which Arte it is impossible to profite without the helpe of these, or such like instructions. To the furtherance of which Arte of Navigation, the said M. Blundeville speciallie wrote the said Treatises, and of mere good will doth dedicate the same to all the young Gentlemen of this Realme."

[4] London. Printed by John Winder, 1594.

Of the six exercises, the first treats of arithmetic; the second of cosmography; the third of globes; the fourth of universal maps of Petrus Plancius; the fifth of M. Blagrave's Astrolabe; and the sixth of the principles of navigation. It is doubtful whether the young gentlemen of his day profited by the interesting work so handsomely dedicated to them if they resembled those so plaintively addressed in the old sea song—

> You, gentlemen of England, who live at home at ease,
> Ah! little do you think upon the dangers of the seas!
> Give ear unto the mariners and they will plainly show
> All the cares and the fears.
> When the stormy winds do blow.

There can be no doubt, however, that Blundeville's popular navigation book was a great boon to the masters of ships, whom he advised in a fatherly way to procure, before entering upon a long sea voyage "a perfect Calendar, the Mariner's Ring or Astrolabe, the Cross-staff, the two globes, celestial and terrestrial, an universal horloge to know the hour of day in every latitude, a Nocturne-labe to know the hour of night, the Mariner's Compass and the Mariner's Card or Chart." To this outfit[15] some very prudent masters added the universal map of Petrus Plancius, serving for both sea and land, and described as a "Map meete to adorn the house of any Gentleman or Merchant that delighteth in Geography." Thus equipped, the master was considered competent to practice the art of navigation, aptly defined by Blundeville as "An Art which teacheth by true and infallible rules how to govern and direct a ship from one port to another safely, rightly and in the shortest time." This is, in clear language, a brief epitome of the seaman's art which so many minds and pens have labored to elucidate in past centuries.

In 1599, Edward Wright, an eminent mathematician, and hydrographer and lecturer on navigation for the East India Company, published his "Haven Finding Art," containing incidentally an account of the log and its uses; also his "Certain Errors in Navigation Detected and Corrected," in which he fully ex-

[15] When Captain Frobisher made his first voyage in 1576, he was provided with Thevat's Cosmographie, Medina's Arte de Navegar, a globe in blank, a clock, an astronomical ring, an astrolabe, a cross-staff, 20 compasses, 18 hour glasses, a navigation chart, Mercator's general map, and three printed charts.

plained the principles upon which the parallels of latitude were constructed in Gerrard Mercator's Universal Map (1569), which principles, as is stated elsewhere, were probably unknown to Mercator himself, as he gave no explanation of them. Wright was a Fellow at Cambridge University when he sent to Blundeville an account in manuscript of the true method of dividing the meridians, together with a specimen chart so divided, and a short table to regulate the division, all of which Blundeville published in his "Exercises" to establish his friend's title to priority of invention. Henceforth rudely constructed globes and erroneous plane charts were no longer used by mariners to estimate courses and distances. Wright also introduced an instrument called the "Sea Rings," by which the altitude of the sun, the hour of the day, and the meridian of the compass might all be determined by inspection, in situations where the latitude was known. He also contrived a mechanical sphere with which he exhibited all the celestial.

Many treatises on globes and instruments appeared at this time (1592) in the brilliant reign of Queen Elizabeth, and famous globes, celestial and terrestrial, were made by skillful hands, those of Molyneux and Sanderson being mentioned in the books with special praise. Sanderson is quaintly described thus in a Harleian manuscript, "Borne a gent, bred a Merchant Adventurer, he invented, made, printed and published the great spheares and globes, both celestiall and terrestriall, being the first soe published in Christendome, for the honor of his countrie, and good of the scholars, gentry, and Mariners of the same." But there was still needed something to simplify the long and intricate calculations used by the sailor to obtain his results, and this was at last supplied by the tables of logarithms, invented and arranged by John Napier, the Lord of Merchiston, who, in 1614, gave to the maritime world his "Logarithmorum Canonis Descriptis." These tables were at once adopted by all seafaring men, and formed the basis of the present system of navigating ships. His friend, Henry Briggs, "who had a genius for numbers," further improved the system of logarithmic tables, and in 1624 Edmund Gunter still further simplified such calculation by his table of artificial sines and tangents, and by his resolution of spherical triangles without the use of secants. Gunter also invented the useful scale known by his name, and introduced the measuring chain.

Napier's great discovery was made known in France by Edmund Wingate in two tracts, thus placing her scientific men under an obligation which they fully discharged at a later period. In 1635 Mr. Gellibrand published his "Discourse Mathematical on the variation of the Magnetic Needle," and in 1637 appeared Richard Norwood's "Seaman's Practice," giving a full account of his measurement of a degree on a great circle of the earth, of his improvement of the log-line and of his method of perfecting a sea reckoning. This treatise and his earlier work on trigonometry were frequently reprinted as the most useful text-books for learning scientifically the art of navigation. An "Epitome of the Seaman's Practice," in many successive editions, was also prepared for the use and instruction of the mariners of the kingdom, of which there was great need. At this time we also hear the commanding voice of Admiral Monson, from the place of his retirement, forcibly advocating the necessity of public lectures on nautical subjects (fourth book of his "Tracts") as follows:

"With pity I speak it, we have not respected the instructing our Mariners, and no marvel that we have sustained so great a loss by shipwreck, for no more our Seamen get by bare Experience, they never endeavor themselves to knowledge." Then, arguing the greater benefit of lectures than books, as a means of keeping the secrets of the art of navigation, after the example of Spain which concealed the situation of rivers and places in the Indies from the English, the gallant admiral philosophizes thus—"It is a question whether a man shall attain to better knowledge by Experience or Learning"—upon which point scholars and mariners even at that early period had many angry controversies. "The scholar accounts the other no better than a Bruit Beast, that has no learning but bare Experience to maintain the Art he professes. The Mariner accounts the Scholar only Verbal, and that he is more able to Speak than to Act. All which is great Arrogance in both, when they ought to reason to assist each other, and especially the Mariner is to receive comfort from the Scholar, for he that has but bare Experience receives that he has by Tradition, and Learning is the Original Ground of all Arts. If we had but a Lecture of Navigation read which Seamen might resort to, they would soon reform their spightful Humours, and confess how needful it is that Learning should be added to Ex-

perience. . . . I am of opinion there is no error the Mariner finds at sea, either in Card, Star, Instrument or Compass, but upon his information may be reduced by the skillful Mathematician and made perfect. . . . It is not Art, but Fear and Care that preserves ships, for if the Masters should presume upon their Art to bear in with any Land, the Rocks would devour ten times more ships than they do. . . . But if the Art can be made perfect, and the errors corrected and reduced to a certainty by the painful study of the Learned, it will prove a happy thing to all Seamen, and by consequence to the whole Commonwealth."

These advanced ideas of a self-taught seaman and admiral of the seventeenth century, and especially his frank declaration of the importance of mathematics to the seaman's art probably found but little sympathy among the tarpaulin officers of his own high rank who were not then, nor for a century later, accustomed to receive science in any form as a handmaid of their profession. Monson, however, was as much of an "old Salt" as any of them, which is proven by his deeds and stratagems[11] at sea, and he was perhaps the first British admiral who had the courage to sustain the mathematicians in their efforts for the advancement of nautical science. He probably had read some of the already mentioned nautical works published in his time, which were to contribute not a little to the improvement of his profession; but whatever the inducing cause of his argument, it was most creditable to his intelligence as a sailor and an officer of large experience. We can almost recognize this veteran in Locker's graphic picture of "The Old English Admiral" on the retired list, "wearing his cocked hat somewhat awry, his buttons and scarlet waistcoat trimmed with gold, with a glass of rum at his elbow, and smoking a cigar—the last remnant of a cockpit education—attended by an old tar—his former coxswain—who ruled the other servants with a rod of iron, rehearsed all his old yarns to the

[11] In the fifth book of his "Naval Tactics," Monson enumerates not less than sixty stratagems employed to great advantage at sea, which were only a fraction of his long experience in twenty-six different ships of war between 1588 and 1635, during the reigns of Elizabeth, James I, and Charles I. He was both a hard fighter and a good writer—a remarkable instance of a naval officer whose writings were considered as valuable as his services afloat and ashore. There are several spirited sketches of Monson and his exploits in a work entitled "The Sea," by F. Whymper, London.

admiral nightly, exaggerating the heroism of his chief in many a story of battle, knowing that each yarn would be washed down with a glass of the admiral's best grog. On one of these occasions, the old coxswain reminded the admiral of the five and forty foot rattlesnake that he killed with a blow of his fan, when the admiral said "Avast Boswell, mind your reckoning there, twas but 12 you rogue, and that's long enough in all conscience."

But the lectures on navigation, so warmly advocated by Monson, were not provided in his time, nor was any additional light shed upon nautical science during the succeeding period of Cromwell, although the navigation act of 1651 made greater demands upon the skill and energy of seamen. Some doubtful points in navigation and nautical astronomy had already been cleared up, but the great problem of the longitude, which had puzzled navigators from the time of Columbus, was not yet solved. Mr. Bond believed that he had unravelled the mystery when he hit upon the true theory of magnetic variation, and by special command of Charles II he published, in 1676, an account of his discovery in a pamphlet entitled "The Longitude Found." But, in the following year, an anonymous writer, heedless of the royal approval of Bond's demonstration, proved its fallacy in a defiant treatise entitled "The Longitude not Found." While their respective adherents were angrily discussing the question, hundreds of vessels engaged in commerce were lost at sea for the want of proper nautical instruments, which disasters finally brought about the foundation of the Greenwich Observatory in 1676. This was the first step taken by the government looking to the development of nautical astronomy and ultimately to the finding of the longitude at sea. Already in 1663, contemporaneously with the French "Academie des Sciences," the "Royal Society of London" had been established for the encouragement of the arts and sciences in general, with Boyle, Newton, Flamstead, Halley,[17] and other great scientists among its earliest members and most frequent contributors, and soon afterwards (1676) was founded the Greenwich Observatory which gave a stimulus

[17] Edmund Halley published his "Theory of the Variation of the Compass" in 1693, and soon afterwards was honored with a naval captain's commission and the command of a ship to enable him to take magnetic observations at sea. He afterwards became Astronomer Royal and presided over Greenwich Observatory until his death in 1742.

to the study of astronomy and navigation. In 1791 there was formed in London a society for the improvement of naval architecture, which offered prizes for best papers upon that subject. This body gave a great stimulus to the art, and both the theory and practice of shipbuilding were much advanced by means of a special school attached to the Naval College at Portsmouth under Dr. Inman's superintendence. But the problem of finding the longitude at sea had not even then made any headway. It needed the incentive of a large pecuniary award and the skill of a practical mechanician to accomplish the desired result by the aid of timekeepers.

It was Gemma Frisius, a cosmographer of Flanders, who, in 1530, first proposed to ascertain the relative longitude of any place by means of watches, then newly invented, and he is said to have constructed a quadrant for this purpose which was simply a modification of the cross-staff. This crude instrument was a step in the right direction, but almost two centuries elapsed before the goal was reached. As early as 1598 Philip III of Spain offered a reward of 1000 crowns to the person who would discover the longitude. The States of Holland, following the example of Philip, offered 10,000 florins for the same purpose. The terrible shipwreck of Sir Cloudesly Shovel's squadron on the Scilly Rocks finally induced the British Parliament to create a board of longitude and to pass an act in 1714, offering a reward of £10,000 for any method of determining the longitude within one degree of a great circle; of £15,000, within the limit of 40 geographical miles; and of £20,000, within the limit of 30 geographical miles, provided such method should extend more than 80 miles from the coast. The French government in 1716 offered a reward of 100,000 livres, and in 1720 and 1747, the Academie des Sciences offered, on its own account, handsome rewards for the discovery of the long-sought longitude. It was a matter of immense importance to every maritime state, but it fell to the lot of English mechanics to invent and make instruments best adapted to the purpose. The most ingenious of them all was John Harrison, who constructed four time-keepers between 1726 and 1763. The board of longitude tested these in various ways, on land and sea, and Harrison was sent to Lisbon in a government vessel to make observations with his time-keeper. He succeeded so far as to correct the dead reckoning a degree and a half. In a subse-

quent voyage to Jamaica, in 1761, his son William Harrison took with him a better instrument, which on his return was found to be in error less than two minutes. Accordingly the Harrisons claimed the reward of £20,000, which after a second voyage to Jamaica, and additional tests of his invention by Dr. Maskelyne and others, was paid in 1765. Two years afterwards John Harrison published a treatise on his time-keeper which is cited as a proof "that inventive power may belong to a mind incapable of explaining clearly its own conceptions." But his invention was a great one—so great in the eyes of the sailors, during the first years of its employment, that they became panic-stricken whenever the time-keeper was allowed to run down. When ships were wrecked or abandoned at sea, the first thought of the captains was to save the chronometer, and we are told that the commanding officers of French ships-of-war on distant stations, at the outbreak of the French Revolution of 1789, sold their ships to subsist the crews, but jealously preserved and carried back to France the chronometers.

Thus the novel expedient of offering pecuniary rewards for the finding of the longitude was attended with considerable success, and it is quite probable that the plain mechanician, Harrison, was much envied by the learned men of the Royal Society. But it must not be forgotten that it was Dr. Nevil Maskelyne, Astronomer Royal, who, in 1754, discovered the method of finding the longitude by lunar observations on shore, and, in 1767, originated the Nautical Almanac, the standard navigator's guide, which has been published annually ever since. We know also that Meyer aided in solving the problem of the longitude by the publication of his lunar tables in 1760. It was under the auspices of the Royal Society, too, that Hadley's Quadrant was made known in 1731, and his sextant in 1761. None of these nautical instruments, however, were then furnished by the admiralty to ships of war. The sailing master was obliged to purchase them out of his meager pay, the cheapest article and the worst being of course obtained for use at sea. Even that delicate instrument, the compass, was not thought worthy of special care, at the end of a cruise being committed to the boatswain, who stowed it away with his tar bucket traps in a dockyard loft with no more concern than if it were a piece of junk.

It might be supposed that, after the discovery of the longitude,

the numerous voyages of exploration and discovery conducted by Cook (in the *Endeavor,* 1772-75), and by other skillful captains, in which some of the best officers of the British navy were trained to deeds of hardihood, would have incited some of them to study the art of nautical surveying, and to become hydrographers. In our day the benefits to young officers from such voyages are immense, but it was not so at the period in question. Indeed the commissioned officers of the British navy had but little knowledge of nautical instruments and no knowledge of hydrography, and even down to 1830—sixty-five years after the discovery of the longitude—"the greatest maritime power in the world labored under the imputation of producing the worst sea charts," says a writer.

With the introduction of chronometers, the operation of "taking the sun" became henceforward one of the most important duties of the day on board of sea-going vessels, but at night the observation of the stars was contrived in the old-fashioned way, with a telescope. Of course oscillations of the ship impeded these observations, and we are told that the novel expedient employed in the sixteenth century to obviate the difficulty by hoisting the observer in a chair between the main and mizzenmasts, was used in the French navy as late as 1770. In the British navy, the duty of "taking the sun" was discharged by the pilots, whose proceedings are thus described in easy flowing rhyme by Falconer, in that wonderful nautical poem "The Shipwreck," which has been styled "a grammar of seamanship, and the only instance of a smooth versification of the language of the sea."[a]

[a] The editor of this poem (J. S. Clarke, 1804) was evidently not aware of the existence of Francisco Barberino's Tuscan verses already quoted in this narrative, and antedating Falconer's poem nearly five hundred years. The latter, however, is unsurpassed in any language for vivid picturing of casualties at sea, and like the former it became an authority, a sort of text-book of practical seamanship in its time. Indeed Mr. Clarke states that many experienced naval officers declared that the rules and maxims laid down in Falconer's poem "for the conduct of a ship in the most perilous emergency, form the best, indeed the only opinions which a skillful mariner should adopt." The modesty or Falconer prompted him to publish it anonymously in 1762, under the title "The Shipwreck, a Poem in Three Cantos, by a Sailor;" but it gained such favor among seafaring men that the authorship was soon revealed. Clarke's edition was corrected from the third edition of 1769, which was wretchedly garbled by a land-lubber.

The pilots now their azimuth attend,
On which all courses, duly form'd, depend:
The compass placed to catch the rising ray,
The quadrant's shadows studious they survey;
Along the arch the gradual index slides,
While Phoebus down the vertic-circle glides;
Now seen on ocean's utmost verge to swim,
He sweeps it vibrant with his nether limb.
Thus height and polar distance are obtained,
Then latitude, and declination, gain'd;
In chiliads next the' analogy is sought,
And on the sinical triangle wrought:
By this magnetic variance is explor'd,
Just angles known, and polar truth restor'd.

This incomplete record of facts derived from many authentic sources shows that England even anticipated France in her efforts to develop the theory of the seaman's art, although depending upon French savants, to a considerable extent, for text-books upon the subject[19]

But it is worthy of note that the progress made in navigation and in shipbuilding both in France and England, down to this period, and for many years subsequently, was due quite as much to landsmen of a mathematical turn of mind as to seamen and captains such as Cabota, Drake, Hawkins, Gilbert and Dampier, who so greatly extended the limits of geographical knowledge, and improved the art of navigation. It is quite certain, however, that even if not a single nautical book had been written, nor a single discovery made, by the scientists before Clerk's time, the practical result on the sea would not have been different. And here arises the question much discussed at different periods by philosophers, historians, and magazine writers—In what consisted the superiority of the English at sea? What were the causes of British superiority at sea? We have elsewhere cited the testimony of Admiral Monson and the philosopher Voltaire upon this subject. When Mr. Clerk stated that "in bringing a single ship to close action, the British seaman has never been excelled," he was quite correct; but he did not live long enough to witness the

[19] One of many evidences of this dependence is found in the case of Mungo Murray, who published, in 1754, in the same volume, the first edition of his "Treatise on Navigation and Shipbuilding," with an abridged translation of Duhamel's and Bouguer's treatises on naval architecture.

naval events of the war of 1812 in which American ships and captains practiced this lesson so successfully against British captains. In fact such was the reliance of Monson and other British admirals in the superior pluck and muscle of their seamen, that they readily took any odds of ships, guns and men against them in battle, and so long as there were Spanish and French fleets to be fought the English were pretty sure to win by laying them close aboard, a lesson in which British commanders alone excelled until they met the captains of American ships in the War of 1812. Indeed it was acknowledged in the columns of the British Naval Chronicle of 1799 that "the decided superiority of the British navy is perhaps not more to be attributed to the bravery of her sailors than to the attention which has been paid by the first scientific characters of the country to every circumstance tending to its improvement." The great mass of English naval officers had a thorough contempt for book-learning of a professional kind, as well as for scientific men generally. "Lead, Latitude and Lookout," says an English writer, "the safeguards used in navigating ships in Dr. Halley's time (1680-1730), were preferred down to a later period by commanding officers to the dry rules of Maskelyne; and it was not until the publication of J. Clerk's "Essay on Naval Tactics" in 1782, that the old sea dogs of that day would admit that any useful idea in naval affairs could be derived from books or landsmen. This treatise of a Scotch country squire, who had never made a voyage at sea, revolutionized the prevailing system of tactics and led to the victories of the great commanders who studied and adopted the new tactics." This book was a great surprise to the whole naval profession. It was the first scientific treatise on naval tactics published in Great Britain, all the others being mere translations of French authors. Only a few copies were at first printed and circulated among the author's friends in the Navy, but some other officers copied the whole work in manuscript. "It was printed," says a writer in the British Naval Chronicle, "during the American Revolutionary War (1782), when the nation was depressed by the disasters of our arms and the want of naval success." Strange it was that a man totally unacquainted with the sea should have found out the cause of the disasters and suggested a remedy which led to the subsequent victories of Rodney, Howe, Duncan and St. Vincent. "Admiral Duncan," says the same writer, "handsomely acknowledged the indebtedness of

himself and other English admirals to Mr. Clerk." Indeed his book had wrought a revolution, not only in tactics, but also in the naval profession itself, which Admiral Howe describes as "a complex service both by sea and land, which all naval officers ought to be well versed in." He uttered this opinion while in command of the British fleet on the North American station during our Revolutionary War. "In that and the previous wars," says the same writer, "single British ships were more than a match for ships of equal force, of any nation, but the large fleets of England had achieved nothing memorable owing to defective tactics." Another evidence of the growing attention of officers of high rank to the theory of their profession is found in the publication by Sir Alexander Schomburg in 1789 of "A Sea Manual," which was held in high repute.[29] In this connection, too, we have the later testimony of Carlyle, whose virile nature appreciated the strong points of British seamen. Quoting from what he styles "A Singular Constitutional History of England," existing only in his fancy, he drew a comparison between the army and navy of England in the Spanish War, concluded in 1763, describing the army as "totally chaotic in a quiet habitual manner," and the navy in a far different sense both as to its ships and organization, as follows:

"With the Naval branch it is otherwise, which is also habitual there. The English, almost as if by nature, can sail and fight in ships; cannot well help doing it. Sailors innumerable are bred to them; they are planted in the ocean, opulent, stormy Neptune clipping them in all his moods forever; and then by nature, being a dumb, much-enduring, much-reflecting, stout, veracious, and valiant kind of people, they shine in that way of life which requires such . . . . For a ship's crew or even a fleet, unlike a land army, is of itself a unity, its fortunes disjoined, dependent on its own management; and it falls, moreover, as no land army can, to the undivided guidance of one man, who has now and then from of old chanced to be an organizing man, and who is always much interested to know and practice what *has* been well organized,

[29] It was questioned at the time whether Rodney got his idea of breaking the enemys line from Clerk's book or had preconceived it. Indeed it was shown that this maneuver had been successfully practiced nearly a century and a half before Rodney's victory in 1782—it was when the Earl of Sandwich sailed through the Dutch fleet under De Ruyter in 1652, and defeated it.

For you are in contact with verities to an unexampled degree, when you get upon the ocean with intent to sail on it, much more to fight on it; bottomless destruction raging beneath you, and on all hands of you, if you neglect for any reason the methods of keeping *it* down, and making it float you to your aim." [21]

In 1800, the superiority of the British at sea was attributed by French professional writers in the *Moniteur,* to the better knowledge of tactics, to the better ships and gunnery of the British, who directed their fire mainly against the hull of the enemy's vessel, dismantling her guns, and decimating her crew, whereas the French directed their fire at the rigging of the enemy. Yet at this very time, the French had reduced naval tactics to a perfect system on paper by the aid of dozens of text-books, and professors of the science in her naval schools, whereas the English had but one text-book upon the subject, and one naval school hardly deserving the name. But unfortunately, says one of the French writers, "the officers of the French navy who have practice, are unacquainted with theory, and those who are acquainted with theory have not hitherto attained practice." In reply to the articles in the *Moniteur,* British writers pointed out that there was another cause of British superiority "which is as much a property of our nation as fog and beef are the characteristics of our island, viz.: the matchless firmness of our seamen, and that, fire as they may at hull or rigging, the French fleet must always be beaten by laying in close aboard." And while admitting the value of the principles inculcated in the only British text-book (Clerk's), which enabled British admirals to take almost any odds of ships, guns or men of an enemy, they contended that Boscawen, Hawke, Rodney, Howe, Hotham, Jervis, Duncan and Nelson, were all authors upon this subject, and that they were "nervously concise rather than eloquently diffuse in their instructions." "Point your guns well, my lads; don't throw away a single shot; see but their whiskers and you will singe them." Admiral Boscawen, surnamed "Old Dreadnaught" by his men, fought a night action, in his shirt, with two Spanish ships which escaped in the

[21] A critical observer in the *Naval Chronicle* expressed the opinion that the Battle of Trafalgar—the greatest of British naval victories—did great injury to the Navy of England. "Since by leaving no rival fleets on the ocean, and ours become but the convoys and carriers of our armies, it lost its former estimation with the country, whose whole attention was now given to our conquering armies."

darkness. These lessons the British tars put in practice with the swaggering confidence expressed in the sea-song of Nelson' time:

British sailors have a knack,
  Haul away! yeo ho, boys!
Of pulling down a Frenchman's Jack,
  'Gainst any odds you know, boys.
Come three to one right sure am I
If we can't beat 'em still we'll try,
To make Old England's colors fly,
  Haul away! yeo ho, boys!

Another very spirited song (anonymous) published in 1805, expresses the feeling of British tars at sight of a Frenchman at sea:

A sail on your lee-bow appears
She looms like a French man-of-war
Then pipe up all hands, my brave tars,
And cheerly for chasing prepare.
  Set each sail that will draw, ease your reefs and be mute,
    Mind how you steer,
    Don't let her veer,
    She'll lose way if she yare,
So steadily down on the enemy bear,
  And give her a British salute.

But now see her top-sails aback,
  She seems making ready to fight;
Up hammocks! down chests! clear the deck!
  And see all your matches alight!
  Now splice the main brace and to quarters away!
    Stand every one
    True to his gun
    'Till the battle be done,
We soon shall compel them to fight, sink or run!
  Huzza! for Old England! huzza!

Among the many possible means of improving the personnel of the navy, that of education was the last considered and attempted by the government of England. It was still believed that the best school for educating young naval officers was the quarterdeck of a man-of-war, which was doubtless good doctrine in those fighting days. And so it happened that more than half a century after France had begun to educate her young "aspirants" for the sea service of the state, and even after the adoption of the same policy

by Russia[2] the first step was taken in England to educate her midshipmen. In 1729 a "Naval Academy" was established in Portsmouth Dockyard by George II. This institution was started on a voluntary self-supporting basis and with a very liberal programme of studies, comprising the elements of a general education, as well as mathematics, navigation, fortification, gunnery, and small-arm exercises, drawing and French language, together with the principles of ship-building, and practical seamanship in all its branches. But the privilege of admission into this college was limited to a small number of the sons of the nobility and gentry, who for the most part declined the honor, and sent their boys to sea without special preparation. In consequence of this neglect, the college languished, and in 1773 it was found necessary to offer a gratuitous education to twenty sons of officers in order to keep its doors open. The number was consequently increased, but these privileged ones were a mere fraction of the number that annually entered the service, and were so persistently ridiculed on account of their theoretical attainments that they laid aside their books, and strove to emulate the majority of their grade in the acquisition of that practical skill which alone was valued in those fighting days.

The French were better educated in the science of war ashore and afloat than their adversaries, which fact did not concern the latter in the least. For the midshipmen, a cockpit education was still held to be sufficient, for which reason the Academy, even after it was raised to the dignity of "Royal Naval College" in 1806, continued to lack hearty support from the navy itself, was looked upon with distrust by veteran officers, and failed to exercise any influence upon the tone or intelligence of the personnel of the service. In this it differed greatly from the French naval schools which were, in a measure, the outgrowth of a wide-spread interest in nautical science, in and out of the profession, and although this did not save France from defeat on the sea, she is nevertheless entitled to the gratitude of the maritime world for the abundant light which her savants shed upon the theory of the seaman's art.

As might be expected, the effect of the system of training

[2] The sagacious Peter the Great, before the close of his reign in 1725, founded at St. Petersburg, a naval school for the benefit of the future marine of the Empire.

adopted in the French navy, and of the want of such training in the English navy, was apparent in the general conduct and bearing of the junior grade of officers in both services. The young aspirants of the French navy, with all the natural propensities of their years, were brought into easy subjection to naval law and discipline by the influence of education afloat and ashore, whereas the midshipmen sailing in the English ships, without any such wholesome influence, were a sadly demoralized and insubordinate lot. We learn that with the exception of a few lads of good family, serving chiefly in flagships, the British midshipmen of the eighteenth century were of low social standing, and that it was customary to estimate their character according to the size and rate of the vessel in which they served. It is also stated that the age of midshipmen ranged from ten to forty-five years, the oldest ones being promoted from before the mast without hope of further advancement; and that in those days a married midshipman was not uncommon, but "Mrs. Midshipman was probably no better than the wife of any other seaman." On the other hand mere boys were made lieutenants without the six years' experience at sea required by the regulations, and there were captains who entered on the ship's books the name of an infant, to be made a midshipman before he laid eyes on salt water. Under such circumstances, without teacher or text-book, and under the undisputed sway of seamen old in years and vice, the honorable though humble grade of midshipman suffered much degradation. The rough ignorant appointees of tarpaulin captains naturally took the lead in every scene of revelry and insubordination, converting the cockpit or reefer's berth into a veritable pandemonium. Occasionally, the breaches of discipline and propriety were so gross as to bring down upon the offenders the severest forms of punishment of that day, by arbitrary captains, such as deprivation of rank, mast-heading, riding on the spanker-boom, marrying the gunner's daughter, confinement in irons, or being made fast in the rigging with legs and arms distended. These punishments were borne with stolid fortitude by the hardened old sailor-midshipman, but it is related of a high spirited youth sentenced "to marry the gunner's daughter," that he jumped overboard and lost his life rather than submit to that disgrace. There were, of course, youths of high tone and character who escaped the contagion of the cock-pit, by manly self-denial and devotion to their profession.

Among these were conspicuous Jervis, Nelson, and Collingwood. Midshipman Jervis (afterwards Earl St. Vincent) who, when unable to pay his mess-bill, lived by himself on the ship's allowance, washed and mended his own clothes, made a pair of trousers out of the ticking of his bed, but preserved his integrity and became a great seaman and officer. Midshipman Nelson was surrounded by similar difficulties, but overcame them all. At the early age of twelve he had his first experience of a naval service in the *Raisonnable* of 64 guns, which prompted him at the end of the cruise to enter the merchants' service in order to better learn the seaman's art. His opinion of the personnel of the navy was expressed in the brief sentence "Aft the most honor, forward the better man," but his prejudices against the navy were overcome at last and he rejoined one of the king's ships. Even at this early period he had become an excellent pilot for decked navy cutters sailing from Chatham to London, and was familiar with all the difficult navigable channels and passages along the coast. Afterwards, in 1773, he volunteered before the mast as "Cock-astern" on board of captain Ludwidge's bomb-ketch, *Carcase*, bound to the Arctic Sea on a voyage of discovery, indicating a thirst for varied professional knowledge which he never ceased to extend during his subsequent career. But his main ambition as a young officer was to be a skillful pilot, which carried with it great influence and power.

Young Cuddy Collingwood, as he was called at school, afterwards Admiral Lord Collingwood[*] used to relate of himself that soon after he joined his first ship—the *Shannon*—at eleven years of age, "the first Lieutenant found him weeping over his forlorn condition, and addressed him in terms of such unexpected kindness that in the simplicity of his heart the youth led the good-natured officer to his chest, and offered him a share of the cake which maternal tenderness had added to his humble outfit." These examples, however, were exceptions to the rule of roughness and severity to midshipmen that prevailed in the British navy. The gruff, stern tones of command greeted the young reefer from the

[*] It is an interesting fact in the professional career of Nelson and Collingwood, that whenever the former got a step in rank, the latter succeeded to the station which his friend had left. This occurred from the date of their promotion to lieutenant to the memorable day at Trafalgar, when Collingwood assumed command in chief of the fleet after the death of his beloved friend.

first day of his service afloat, and the prospect in store for him even among his messmates was something like that pictured to Peter Simple by Mr. Trotter when he conducted that young gentleman to the cockpit: "Now youngster, you may do as you please. The Midshipmen's mess is on the deck above this, and if you like to join, why you can; but this I will tell you as a friend, that you will be thrashed all day long and fare very badly. The weakest always goes to the wall there, but perhaps you don't mind that."

Such were the midshipmen who sailed in the king's ships in the eighteenth century. They were not then addressed by the more modern designation of "young gentlemen," simply because they were not expected to act in that capacity. They regarded the absence of refinement as an evidence of seamanlike character; but they disdained the language and manner of the drawing-room, and gloried in serving under such an officer as the famous Jack Larmour, who, while acting as first lieutenant of the *Hind*, wore the dress of a common sailor, and was found one day setting up his rigging with a marlinspike slung round his neck and a lump of grease in his hand. We are told that "Lieutenant Bowling's dress consisted of a soldier's coat, altered for him by the ship's tailor, a striped flannel jacket, a pair of red breeches japanned with pitch, clean grey worsted stockings, large silver buckles that covered three-fourths of his shoes, a silver-laced hat whose crown overlooked the brims about an inch and a half, a black bob-wig in buckle, a check buckle, a silk handkerchief, a hanger with a brass handle girded to his thigh by a tarnished lace belt, and a good oak plant under his arm." This was the holiday get-up of a lieutenant shortly before the first introduction of a naval uniform in 1748; but for long afterwards, it was not unusual for the lieutenant to have only one uniform coat amongst them, which they wore by turns, as they had to go away on duty; whilst on board, they wore such old clothes as circumstances permitted or suggested; a second-hand soldier's red coat being, it is said, that which came most frequently to hand. As a majority of the lieutenants were promoted from before the mast, the gun-rooms of many ships acquired a low tone in manners, morals and dress. Nor did they consider it derogatory to their dignity to be obliged to address the captain humbly, cap-in-hand, or to receive him in a body at the gangway when he came on board drunk as a lord after a midnight debauch. How fallen was the popular lieutenant

of the eigtheenth century from the high type of Monson's days when he was expected to be at least a gentleman in dress and demeanor, if not an experienced sea-officer, and was called upon to perform only the offices of a gentleman. And what could be expected of the midshipmen, always inclined to outstrip their senior afloat or ashore in deviltry and riotous conduct. It will hardly be believed that, even as late as 1779, an English midshipman was hanged on the charge of murdering his mother on the deck of a man-of-war, and that another midshipman suffered the same penalty for attempting to raise a sedition amongst American and French prisoners on board a ship bound to England from this country. But, at the outbreak of the French revolution, a better class of boys—some even of noble birth, following the example of the young Duke of Clarence, obtained midshipmen's warrants, which, according to the testimony of some officers "was not an unmixed gain." One ship, in particular, had a great number of these lordlings, who were placed under the special care of the captain. The younger ones were allowed to reef and furl the mizzen-topsail, and one day when they were aloft awkwardly furling, the captain impatiently sung out to them, "My lords and gentleman, and you right honorable lubbers on the mizzen-topsail yard, roll that sail up and come down."[a] Of course the order was obeyed by the youngsters, whose favor the diplomatic captain knew how to conciliate. It was among these that the fops and dandies of the navy were found, who, then, as now, had to bear the brunt of much ridicule. A midshipman of this class who had his coat so thickly set with buttons down the lapel that no cloth was visible between them, was once severely reproved by his captain who asked him if his father was not a button maker. "These fops think it the first duty of a naval officer to set off his person to advantage, to spend hours over his chest-lid dressing table, keeping a brother officer on deck beyond the hour of his relief, and giving him a cold breakfast." Another class of young officers is called the "Blood" who "delights in rows, conceals his uniform in a surtout, and with a round hat and cudgel storms the town." There was also much disregard of the uniform and side arm prescribed—"one wears a sword as long as himself, another a dirk so small that you would swear it had been purloined from a lady's head, and not an officer in twenty wearing the sword ap-

[a] Brenton's "Life of Sir John Jervis," London, 1838.

pointed for him by the regulations of the service. Sometimes ridiculous toys were worn as side arms (1818). There was a better tone, and more strictness in dress and deportment on flagships under the commander-in-chief's eye. But even the highest rank did not always command the outward signs of respect."

When the young Duke of York first joined Admiral Howe's ship, as a midshipman, the former kept on his hat in presence of the captains assembled to pay their respects, which singular occurrence was thus commented upon by a sailor of the same ship,—"Why, how should he know manners, seeing as how he never was at sea before." But whether of royal, aristocratic or plebeian birth, the midshipman was under all circumstances a singular compound of folly and manliness, a puzzle and a plague to commanding officers, and probably he will ever be so.[25] Perhaps the enthusiastic nautical missionary of Dartmouth, John Flavel,[26] who vainly attempted to reform seamen about this time, had in his mind also the young reprobates of the cockpit when he wrote his "Navigation Spiritualized; or a New Compass for Seamen, consisting of 32 points." It was a noble effort made in a barren field, but the fault was not with Flavel who devoted many years of his life to the thankless task of saving the souls of seamen.

> Through many fears and dangers seamen run,
> Yet all's forgotten when they do return.

As yet the able writers of sea stories, such as Scott and Marryatt, had not appeared to set aflame the imagination of youth and send them to sea, but there were thousands of young sailors in all the seaports every one of whom was a story teller—a romancer if necessary—who were the center of admiring groups of youngsters, and they were better and more inspiring than books.

No missionary ever before attempted to spiritualize in flowing rhyme the seaman's art, or to derive from its methods and appliances such pointed lessons of morality and Christianity. To his mind, the world was a sea—"unstable as water and having the

[25] The midshipmen were held to the responsibilities of men when afloat and were allowed only a modicum of sleep. In those watchful days officers slept with one eye open, so to speak, and it was George III himself who fixed the ration of sleep necessary for individuals as follows: 6 hours for a man, 7 hours for a woman, and 8 hours for a fool.

[26] John Flavel, born about 1627—died 1691—wrote his "Navigation Spiritualized" in 1682—his various works were collected after his death and published in two volumes folio.

same brinish taste and salt gust." In the Scriptures he saw perfectly revealed what he called Spiritual Navigation—the art of arts—whose rules he found "dispersed up and down therein." Unfortunately, this exalted view of the seaman of that day was far above their comprehension, although in some particulars it must have appealed strongly to their nautical sense, as for example, when describing the word of God as a Compass, the missionary launches his figurative conception of this wicked world as follows:

> This world's a sea, wherein a numerous fleet
> Of ships are under sail. Here you shall meet
> Of every rate and size; frigates, galleons,
> The nimble ketches and small pickeroons:
> Some bound to this port, some where winds and weather
> Will drive them, they are bound they know not whither.
> Some steer away for heaven, some for hell;
> To which some steer, themselves can hardly tell.
> The winds do shape their course, which though it blow
> From any point, before it they must go—
> They are directed by the wind and tide
> That have no compass to direct and guide.

But there were captains who exercised fatherly care over their midshipmen, and among these Nelson was pre-eminent. His own professional career is a striking evidence of what a limited education, combined with energy, perseverance and pluck, could accomplish in his time, and in his communications with midshipmen he never failed to encourage them to go and do likewise. Writing to a midshipman just appointed (1784) he thus advised him,—"As you from this day start in the world as a man, I trust that your future conduct in life will prove you both an officer and a gentleman; recollect that you must be a seaman to be an officer; and also, that you cannot be a good officer without being a gentleman. I am always, with sincere good wishes,

"Your true friend, Nelson & Bronte."

Lady Hughes, who was on board the *Boreas* frigate when commanded by Nelson, testifies to his constant attention to the welfare of the numerous young gentlemen "who had the happiness of being on his quarter deck." "It may reasonably be supposed that among the number (30) there must have been timid spirits, as well as bold; the timid he never rebuked, but always wished to show them he desired nothing that he would not instantly do

himself. And I have known him say—'Well, sir, I am going a race to the mast-head, and beg I may meet you there.' No denial could be given to such a request, and the poor little fellow instantly began to climb the shrouds. Captain Nelson never took the least notice in what manner it was done; but when they met in the top, spoke in the most cheerful tones to the midshipman, and observed how much any person was to be pitied who could fancy that there was any danger, or even anything disagreeable in the attempt." On the same principle he went every day into the school-room, observing the mode in which they pursued their nautical acquirements; and at twelve o'clock he was always the first on deck with his quadrant. No one could then neglect his duty. When invited to dine with the Governor of Barbadoes, he took a midshipman with him, and on presenting him to the Governor said, "Your Excellency must excuse me for bringing one of my midshipmen. I make it a rule to introduce them to all the good company I can, as they have few to look up to besides myself, during the time they are at sea." Lady Hughes enthusiastically adds: "Who is there but must allow that this excellent manner of making his midshipmen feel that the attainment of nautical knowledge and experience was a pleasure instead of a task, proceeded from the genius and astonishing goodness of heart which were so conspicuous in Captain Nelson?" He was often accompanied by as many as ten midshipmen in his barge, when making visits of ceremony, believing it to be beneficial to his young gentlemen in their professional career.

It was Nelson who, when in command of the *Agamemnon* (1793), 64 guns, in the Mediterranean, instructed the midshipmen of his ship in these memorable words: "There are three things, young gentlemen, which you are constantly to bear in mind: first, you must always implicitly obey orders, without attempting to form any opinion of your own respecting their propriety; secondly, you must consider every man as your enemy who speaks ill of your King; and thirdly, you must hate a Frenchman as you do the devil."

It is singular that Nelson, in one of his letters to a friend, admitted that he never was well in bad weather at sea, which may be an encouragement to some young officers who may contemplate resignation from the service on account of similar weakness.

Many writers of nautical tales and romances, from Dr. Smol-

lett to Captain Marryat and Chamier in England, some of whom passed through the fiery ordeal of a midshipman's life in the olden time, have striven to portray this most bizarre of naval characters. But there is no such life-like picture of him as is limned in "The Orlop," one of the immortal Falconer's lighter poems, descriptive of the cockpit manners of midshipmen and of their dismal abode on the orlop deck of a ship of war—far removed from the cheering light of day. We cannot forego the pleasure of exhuming this almost forgotten poem, which though devoid of poetic merit, is nevertheless delicious to every nautical ear and briny taste, redolent of the pungent atmosphere of the cockpit, and brim full of its eccentricities. Never before had rhymester chosen such a theme, and never since has any nautical bard ventured to compete with Falconer in the treatment of the subject.[27]

THE ORLOP.[28] (About 1762.)

Aid me, kind muse! so whimsical a theme,
No poet ever yet pursued for fame:
Boldly I venture on a Naval scene,
Nor fear the critic's frown, the pedant's spleen:
Sons of the ocean, we their rules disdain,

[27] It is stated that manuscript copies of "The Orlop" originally entitled "The Midshipman"—had been in the possession of naval officers many years previous to its publication in Vol. 2d of the "British Naval Chronicle," of 1799, in which it appeared anonymously over the signature of Nauticus. But in Dodd's edition of William Falconer's Poems, 1808, "The Orlop" was included as an acknowledged production of his facile pen. This remarkable man was born in Edinburgh, in 1730, of poor parents—went to sea before the mast as an apprentice on board the merchant ship *Britannia*—was appointed in 1757 as midshipman on the *Ramillies*, in which vessel he wrote the "Ninety-gun Ship," and after she was wrecked, he wrote "The Loss of the *Ramillies*." Then he joined the *Britannia* again, as mate, in which vessel he was also wrecked on the Coast of Greece, and this event he made the subject of his best poem, "The Shipwreck." By the favor of the Duke of York, to whom he had dedicated this poem, he again entered the navy as a midshipman, at the age of 32, on board Sir Edward Hawke's ship, the *Royal George* and while serving in her he probably wrote "The Midshipman," which acquired great popularity in the fleet. He was afterwards appointed purser on the frigate *Glory*, in which he finished his "Marine Dictionary." Afterwards he lived in a garret in London, writing for critical reviews. Finally, in 1769, he sailed for India as purser on the frigate *Aurora*, which vessel, after touching at the Cape of Good Hope, was lost at sea with all hands.

[28] British Naval Chronicle, Vol. II

Our bosom's honest, and our style is plain:
Let Homer's heroes, and his Gods, delight;
Let Milton with infernal legions fight;
His fav'rite warrior, polish'd Virgil show;
With love and wine, luxurious Horace glow—
Be such their subjects; I another choose,
As yet neglected by the laughing muse.
Deep in that fabric, where Britannia boasts
O'er seas to waft her thunder, and her hosts,
A cavern lies! unknown to cheering day;
Where one small taper lends a feeble ray;
Where wild disorder holds her wanton reign,
And careless mortals frolic in her train.
Bending beneath a hammock's friendly shade,
See Aesculapius all in arms displayed:
In his right hand th' impending steel he holds,
The other, round the trembling victim folds,
His gaping myrmidon, the deed attends,
Whilst in the pot the crimson stream descends:
Unaw'd, young Galen bears the hostile brunt,
Pills in his rear, and Cullen in his front;
Whilst, muster'd round the medicinal pile,
Death's grim militia stand in rank and file.
In neighboring mansions, lo! what clouds arise;
It half conceals its owner from our eyes;
One penny light with feeble lustre shines,
To prove the mid in high Olympus dines:
Let us approach—the preparation view!
A cockpit beau is surely something new.
To him Japan her varnish'd joys denies;
Nor bloom for him the sweets of Eastern skies:
His rugged limbs no lofty mirror shows,
Nor tender couch invites him to repose:
A pigmy glass upon his toilet stands,
Crack'd o'er and o'er by awkward, clumsy hands:
Chesterfield's page polite, the Seaman's Guide,
An half-eat biscuit, Congreve's Mourning Bride
Bestrewed with powder, in confusion lie,
And form a chaos to th' intruding eye;
At length, this meteor of an hour is drest
And rises an Adonis from his chest:
Cautious he treads lest some unlucky slip
Defile his clothes with burgou or with flip:
These rocks escap's, arrives in statu quo;
Bows, dines and bows, then sinks again below.
Not far from hence a joyous group are met,
For social mirth and sportive pastime set;
In cheering grog the rapid course goes round,
And not a care in all the circle's found.

Promotion, mess-debts, absent friends and love,
Inspir'd by hope, in turn their topics prove:
To proud superiors then, they each look up,
And curse all discipline in ample cup.
Hark! yonder voice the mid to duty calls!
Thus summoned by the Gods, he deigns to go,
But first makes known his consequence below:
At slavery rails, scorns lawless sway to hell,
And damns the pow'r allow'd a white lapel:
Vows that he's free! to stoop, to cringe disdains—
Ascends the ladder, and resumes his chains.
In canvass'd birth, profoundly deep in thought,
His busy mind with sines and tangents fraught,
A Mid reclines; in calculation lost;
His efforts still by some intruder crost:
Now to the longitude's vast height he soars,
And now formation of lapscous explores;
Now o'er a field of logarithms bends,
And now to make a pudding he pretends:
At once the sage, the hero, and the cook,
He wields the sword, the saucepan and the book.
Opposed to him a sprightly messmate lolls;
Declaims with Garrick, or with Shuter drolls:
Sometimes his breast great Cato's virtue warms,
And then his task the gay Lothario charms;
Cleone's grief his tragic feelings wake,
With Richard's pangs th' Orlopian Cavern shake!
No more the mess for other joys repine;
When pea-soup entering shows 'tis time to dine.
But think not meanly of this humble seat,
Whence spring the guardians of the British fleet:
Revere the sacred spot, however low,
Which form'd to martial acts—an Hawke! an Howe![*]

In striking contrast with this poem as to spirit and expression is the following weak effort of an anonymous writer to picture the discontented midshipman in 1804, entitled—

THE MIDSHIPMAN'S COMPLAINT.

When in the cockpit all was grim,
And not a mid dared show his glim,
A youth was all alone.
He scratched his sconce, survey'd his clothes,

[*] In the above allusion to his commanding officer on board the *Royal George*—Admiral Hawke, called by Keppel the "Father of the British Navy"—Midshipman Falconer performed a very graceful act. Howe and Rodney were worthy pupils of Hawke.

Then took another cheering dose,
And then began his moan:—
When first on board this ship I went
With belly full I was content,
No sorrow touch'd my heart;
I view'd my coat so flash and new,
My gay cockade and hanger too,
And thought me wondrous smart.
But soon, too soon, my cash was spent,
My hanger pawn'd, my coat was rent,
My former friends I miss'd:
And when of hardships I complain,
My mess-mates swear 'tis all in vain,
And ask what made me list?
Shivering I walk the quarter-deck,
And dread the stern lieutenant's check,
Who struts the weather side;
With glass and trumpet in his hand,
He bellows forth his harsh command,
With arrogance and pride.
But hark! I hear the caitiff tread—
Another dose and then to bed,
"Of every joy bereft;"
He shakes his bottle with a flout,
The poor half-pint was quite strain'd out,
Not one kind drop was left.
The youth with rage indignant burns,
Into his hated hammock turns,
Alas! not long to sleep.
The quarter-master, with hoarse tongue,
Shakes him, says the bell has rung;
He's roused the watch to keep.
Rising he cries "tip us a light,
Old square-toes! here, how goes the night?
Why sir, it rains and blows;
O, damn my eyes, I hear the rout,
D'ye spy a stray great coat about?"
Then swearing up he goes.

It now remains to inquire into the origin of the title and office of "midshipman," with whom we have to deal almost exclusively in the succeeding chapters of this imperfect narrative. It might be supposed that the old naval chronicles of England, extending back to the time when her naval service became a distinct profession, would throw some light upon the subject, but none of the English writers who have had access to those chronicles give us any definite information on this point. Indeed it would seem that

the grade of midshipman was too insignificant in its origin to have attracted the attention of professional writers of that period. Samuel Pepys, Secretary of the Admiralty during portions of the reigns of Charles II and James II, gives the complements of ships commissioned in his time, but neither in these nor in his memoirs does he even allude to the title of midshipman We doubt very much if any allusion to them can be found in Pepys' manuscripts treasured up in Magdalen College. There is no mention of them in the "Sailing and Fighting Instructions" of 1660 or 1686, nor in the pay-lists down to the latter year; but they appear for the first time, so far as we know, in the prize lists of 1688. Even "Bill Falconer," as he was familiarly called,—a midshipman of the date of 1757,—then not far distant from the date we are seeking, and with witnesses of the fact still perhaps living, gives us, in his "Marine Dictionary" (1769) nothing more definite than this—"Midshipman, a sort of naval cadet, appointed by the captain of a ship of war, to second the orders of the superior officers, and assist in the necessary business of the vessel, either aboard or ashore. . . . Midshipman is the station in which a young volunteer is trained in the several exercises necessary to attain a sufficient knowledge of the machinery, discipline, movements and military operations of a ship to qualify him for a sea officer." Captain Glascock, of the British navy, who had facilities for a full investigation of the subject, is no more definite than Falconer. "It is not exactly known," says he, "how this class of officers came upon the ships' ratings, for, in the complements of 1620 they are not mentioned. But it is probable that the two services were frequently mixed together in sea fights, and as numbers of volunteers were permitted to embark who did duty both as soldiers and sailors, the title originated as a middle distinction, and afterwards acquired stability in the nautical department." Then, in a sort of despair, he adds—"The office of Master's Mate is ancient; but it came to pass that Midshipmen were established in our men of war."[*]

This is not so satisfactory as the result obtained by an officer of our own navy, Rear Admiral George H. Preble, who during his early career kept a Naval Commonplace Book which he made the repository of such interesting facts relating to his profession as he gleaned from nautical chronicles within his reach. Of the in-

[*] Glascock's "Naval Officer's Manual."

formation he obtained concerning the origin of naval titles, the following in regard to midshipmen is interesting:

"The larger class of vessels of the old build had immensely high forecastles, quarterdecks and round houses, but no gangways as now. There was, therefore, no means of going from the quarterdeck to the forecastle without descending into the waist; hence, messengers were necessary in order to save the captain and the officer of the watch from the necessity of ever deserting their station. These messengers took the orders from the officer on the quarterdeck and carried them to the forecastle, and likewise brought the various reports from the officers stationed forward, to those in command abaft. Thence, from their station, these messengers were called 'midship-men.' It was from this class, and that of quartermasters, that the master's mates were generally taken, as the contact into which they were generally thrown with their superior officers led to this distinction when their conduct was meritorious. The promotions from the class of midshipmen were much more numerous than from among the quartermasters; the former being necessarily selected from active young men, while the latter were taken from the thoroughbred old tars. The patronage invested in the captains of ships of war gradually led to the introduction into these stations of young men of respectable families, who might, with a slight degree of interest, hope for speedy advancement. Later, a set of youngsters were introduced into the service by what was called a King's Letter—these were called King's Letter Boys, and were but little relished by the rougher class of their associates, for having, as they termed it, 'come in at the cabin windows instead of at the hawse holes.' The midshipmen at first messed with the ship's company, having one or more tables given them on the lower deck according to their number; they afterward, in some vessels, had the head of one of the tiers given them as a mess place, the quartermasters and boatswains' mates having the other. Those midshipmen or masters' mates in whom the captain or officers took an interest were occasionally invited to their table, and, in process of time, the custom became general."

But there is lacking here a reference to the source of the information, which we cannot supply, and the admiral evidently failed to discover the year in which the title of midshipman was created. He vouches, however, for the correctness of the above

facts, and reiterates the statement that midshipmen were originally rated as "boys" who lived and messed in the "cable tier" amid-ship, and so obtained their title in the British navy.

Failing, therefore, to fix the precise time at which this class of officers first appeared in the ratings of British ships-of-war, we must content ourselves with a knowledge of the fact—which seems undoubted—that they received their title from the station they filled at sea.[a] Later, the King's Letter-boys were called "youngsters" until they became "midshipmen," and this appellation was contemporary with the "aspirants" of the French navy. Still later, in the British navy, midshipmen were familiarly called "reefers," which name originated from the fact that it was part of their duty to superintend in the "tops" the operation of reefing sail. Finally, when the general tone of the navy was elevated, they received the more dignified appellation of "young gentlemen," when addressed officially and collectively by their superior officers, and thenceforward they were expected, under all circumstances, ashore or afloat, to be worthy of the distinction. This was in the time of George III, styled the "first gentleman of England," when the navy of England won immortal fame under Howe, St. Vincent, Nelson, Collingwood and others. These titles, short and crisp, are still in use, but in some other navies this class of officers are known by rather pompous, high-sounding titles, corresponding to the genius and language of the nation. The French, always precise in the designation of their officials, styled the junior grade of their navy successively Gardes de la Marine, Elèves de la Marine, and Aspirants de la Marine, the last being now their recognized title. The Spaniards call them Caballeros Guardias Marinas; the Portuguese, Aspirantes a Guardas Marinhas; and we find recorded in the Annales Maritimes of 1842, under the head of foreign naval intelligence, that the "Guarda Marinha graduado Raymundo d'Assumpcao dos Santos," and the "Aspirante a Guarda Marinha Francesco de Campos Sampayo Smith" received orders to join the brig-of-war *Tejo* bound to the Indies. Fortunately for the safety of the brig, there were but few such names on her books, and how the uncommon one of Smith found its way into the dominion and navy

[a] The anagram made out of the word "midshipman," viz., "mind his map," had no significance in this connection, being merely a curious discovery.

of Portugal is a matter for conjecture. In the following schedule one can see at a glance the length and breadth and meaning of the titles given to the junior class of officers in all the navies of the world:

Nation.	Title	Meaning of Title.
France,	Aspirant de Marine.	
Spain,	Caballero Guarda Marina.	
Portugal,	Aspirante a Guarda Marinha.	
Brazil,	Aspirante a Guarda Marinha.	
Chili,	Guardia Marina.	
Italy,	Aspirante di Marina.	
Greece,	Hyp-axiomaticos.	Under officer.
Turkey,	Mulazim.	
Russia,	(Characters)	Under Officer.
China,	(Characters)	Pupil or Naval Cadet.
Japan,	(Characters)	Student officer.
Netherlands,	Adelborst der 2st Klasse.	
Denmark,	Söcadet.	
Germany,	See-Cadet.	
Austria,	See-Cadet.	
Sweden,	Siö Kadett.	
England,	Midshipman.	
United States,	Midshipman (Cadet).	

There was doubtless something inspiring in the old-time titles which gave to mere youths the consideration of men, with all the responsibility attached thereto, and nerved them to gallant deeds in their humble sphere. In the grand fighting days when the waters of Europe were red with the blood of English, French, Dutch and Spanish seamen, every individual in the ship's company carried his life daily in his hands, and none more so than the midshipman, whose station was in the waist, and who in the discharge of his duty had to run the gauntlet of the enemy's fire while bearing orders and messages between poop and forecastle. The waist was then called the "slaughter-house" because the enemy's fire was often directed against it with murderous effect, and it was here doubtless that some of the gallant young fellows who rose so rapidly from the cockpit to the cabin first developed their heroic natures. Elsewhere we have stated the mortality among admirals in command, especially at the battle of Trafalgar, but the comparative loss of midshipmen was also very great. In the action of H. M. S. *Nymphe* (Captain Pellew), 1793, with the

French frigate *Cleopatra*, there were three midshipmen killed (the only officers lost) and two wounded. In the Battle of the Nile (August 1-2, 1798), won by Nelson with a fleet of fifteen ships, only three midshipmen were killed, but thirteen were wounded, and for the first time perhaps, in the history of naval engagements, a naval schoolmaster (of the *Goliath*) was wounded. In the Battle of Trafalgar (October 21, 1805), won by Nelson with a fleet of thirty-three vessels of all sorts, we learn from the Vice-Admiral Collingwood's several reports that fourteen midshipmen were killed, forty-six midshipmen wounded, which justified one of the surviving midshipmen in writing that "our class of officers suffered severely." Only two captains of ships were killed, and four wounded, and only eight lieutenants were killed and fifteen wounded in that grand encounter; only among the admirals was there greater mortality than among the midshipmen—two out of the six in various commands being killed, two wounded and two taken prisoners. It mattered not to the midshipmen that they were not mentioned in the early naval regulations, or but seldom mentioned in dispatches for gallant conduct, or that they were not invested with any special charge by the government; they performed manfully such duties as were prescribed by their commanding officers, and literally fought themselves into official notice.[a] Their friend and champion, Falconer, has left us in his "Marine Dictionary" a sketch of the duties and embarrassments of a midshipman in the British navy which is worthy of special notice, as it reveals facts concerning the relations of the officer to the sailor not found elsewhere in the chronicles of that period:

"On his first entrance in a ship of war, every Midshipman has several disadvantageous circumstances to encounter. These are partly occasioned by the nature of the sea service, and partly by the mistaken prejudices of people in general respecting naval discipline, and the genius of sailors and their officers. No character, in their opinion, is more excellent than that of the common sailor, whom they generally suppose to be treated

[a] We are unable to state the casualties among the Aspirantes of the French fleets in these engagements, but they were probably numerous, and all the world is familiar with the heroic self-sacrifice of Casabianca, a boy of ten years, who served in his father's ship, the *l'Orient*, at the Battle of the Nile, and rather than abandon his post without orders, suffered himself to be blown up with the ship. He takes high rank among the historic midshipmen of the world's navies.

with great severity by his officers, drawing a comparison between them not very advantageous to the latter. The Midshipman usually comes aboard tinctured with these prejudices, especially if his education has been among the higher rank of people; and if the officers happen to answer his opinion, he conceives an early disgust of the service, from a very partial and incompetent view of its operations. Blinded by these prejudices, he is thrown off his guard, and very soon surprised to find amongst those honest sailors a crew of abandoned miscreants, ripe for any mischief or villany. . . . If the Midshipman on many occasions is obliged to mix with these, particularly in the exercise of extending or reducing the sails in the tops, he ought resolutely to guard against this contagion with which the morals of his inferiors may be infected. He should, however, avail himself of their knowledge, and acquire their expertness in managing and fixing the sails and rigging, and never suffer himself to be excelled by an inferior. He will probably find a virtue in almost every common sailor which is entirely unknown to many of his officers; that virtue is emulation. There is hardly a common tar who is not envious of superior skill in his fellows, and jealous on all occasions to be outdone in what he considers as a branch of his duty. Nor is he more afraid of the dreadful consequences of whistling in a storm than of being stigmatized with the opprobrious epithet of *lubber*. Fortified against this scandal by a thorough knowledge of his business, the sailor will sometimes sneer in private at the execution of orders, which to him appear awkward, improper, or unlike a seaman. . . . Hence the Midshipman who associates with these sailors in the tops, till he has acquired a competent skill in the service of extending or reducing sails, etc., will be often entertained with a number of scurrilous jests at the expense of his superiors. Hence also he will learn that a timely application to these exercises can only prevent him from appearing in the same despicable point of view, which must certainly be a cruel mortification to a man of the smallest sensibility."

After indicating the studies which were then considered essential to the improvement of the midshipman[22] Falconer continues

[22] The favorite text-book of that day was John Hamilton Moore's "Practical Navigator," which reached its tenth edition in 1799. Mr. Moore had but a poor opinion of other nautical works then used, if we may judge from the advertisement at the end of his "Navigator," informing seafaring men that "he sells no sea books, charts or instruments, but such as may

thus: "Unless the Midshipman has an unconquerable aversion to the acquisition of these qualifications, he will very rarely want opportunities of making progress therein. If the dunces, who are his officers or mess-mates, are rattling the dice, roaring bad verses, hissing on the flute, or scraping discord from the fiddle, his attention to more noble studies will sweeten the hours of relaxation. He should recollect that no example from fools ought to influence his conduct, or seduce him from that laudable ambition which his honor and ambition are equally concerned to pursue."

This admirable sketch of the official life and surroundings of the midshipmen of his day may be accepted as Falconer's own experience while serving in that capacity in the British navy, just as his famous poem "The Orlop" may be received as a truthful representation of the daily, unofficial cockpit life of midshipmen of the period in question.[84]

Previously the world outside of the naval service knew nothing of this class of officers, and even down to a much later period, when novelists and magazine writers began to make them the subject of their pens, they were hardly mentioned except in naval orders and regulations. Perhaps, in exposing their follies and

be depended upon, consequently he excludes all those old, inaccurate and erroneous publications, the depending upon which has often proved fatal to shipping and seamen." Moore also taught navigation at the following rates:

For teaching navigation complete, £5. 5. 0.
For teaching a short method of keeping a journal at sea, £3. 3. 0.
For teaching the double altitudes and lunar observations, £2. 2. 0.
Board and lodging being furnished in his house if desired.

[84] Among other later poems descriptive of a midshipman's life in the navy or of the naval service, may be mentioned a very long poem of 400 pages entitled "The Cruise, a Poetical Sketch in Eight Cantons by a Naval Officer," published at London in 1808, giving a faithful description of naval life during the fighting epoch, for the benefit of the rising generation of young sailors. It eulogizes distinguished naval officers, treats of discipline, the routine of a man-of-war, the customs of the service, but only incidentally of the midshipman's life and habits. This, however, was no more like Falconer's graphic picture than was the later poem in three cantos (3000 lines) entitled "The Pleasures of Naval Life" by Peter Downey, surgeon of H. M. Ship *Thisbe*, published in 1811. Later still appeared "The Adventures of Johnny Newcome in the Navy," a poem in four cantos, by Alfred Burton, published in 1818, with sixteen humorous engravings.

temptations to the light of day, Falconer may have been the means of saving some of them from moral and professional shipwreck. It is evident that *he* was not tainted by the corruption of the cock-pit, and remembering the great names it gave to the naval service of England, we must look upon it with the generous forgiving spirit of the old and most prominent midshipman of his day:

> But think not meanly of this humble seat,
> Whence sprung the guardians of the British Fleet,
> Revere the sacred spot, however low,
> Which form'd to martial acts an Hawke, an Howe.

Of the better class of midshipmen of this period we find in the "Acadian Recorder" of Halifax, in 1813 (Vol. 30), the following eulogy written by a friend of the corps in reply to a scurrilous attack by a defamer.

THE MIDSHIPMAN.

1. Of Britain's future hopes I sing,
From which unnumbered chiefs shall spring,
To guard their native land and king;
In short, I sing the *Midshipman.*

2. When tossing on old ocean's foam,
Perhaps a thousand leagues from home,
No danger can his mind o'ercome
Or daunt the *Midshipman.*

3. Should hosts of foes appear in sight,
With joy he hails the coming fight,
No hostile fleets can e'er affright
The little fearless *Midshipman.*

4. When shot like hail fly thick around,
Inflicting many a fatal wound,
Unaw'd he hears the cannon sound;
'Tis music to the *Midshipman.*

5. The battle o'er, he views with pain,
The deck spread o'er with numbers slain,
Nor pleads a wounded foe in vain,
To move the gallant *Midshipman.*

6. His faults partake of virtues hue,
For still to king and country true,
And though temptation may subdue,
Can never change the *Midshipman.*

7. From thence a Nelson,—Duncan sprung,
Brave Hood, and numbers yet unsung;
Let not then a despiteful tongue
Defame the name of *Midshipman.*

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE PRINCIPLES OF THE DEVIATION OF THE COMPASS AND ITS CORRECTION.

By LIEUT.-COMMANDER L. M. NULTON, U. S. Navy.

1. **Introductory.**—These notes are not a complete treatise on the deviation of the compass but are an attempt to explain, by simple laws of magnets, how deviation is produced by the iron of a ship, and, by the same laws, how the deviation may be corrected. It is an explanation of *principles involved,* based upon the physical laws of the attraction and repulsion of magnets.

2. **Natural Magnets or Lodestones.**—The name magnet, or lodestone, was given by the ancients to certain hard black stones which possessed the property of attracting to them small pieces of iron or steel.

3. **Artificial Magnets.**—If a piece of iron, or better still a piece of hard steel, be rubbed with a lodestone, it will be found to have also acquired the properties characteristic of the magnet; it will attract light bits of iron, and, if hung up by a thread, it will point north and south.

4. **First Laws of Magnets.**—If two magnets be suspended as above and bought near each other, it will be found that the north seeking end of either magnet will repel the north seeking end of the other magnet; similarly, if the south seeking end of one magnet be brought near the south seeking end of the other magnet, they will repel each other; if, however, the north seeking end of one magnet be brought near the south seeking end of the other magnet, these ends will attract each other. The ends of the magnets are called its poles. This brings to notice the facts that the character of the magnetism of one pole of a magnet is different from that of the other pole, and the important law of

magnets, that *like poles repel* each other, and, that *unlike poles attract* each other.

5. Polarity Represented by Colors.—It is convenient to represent the character of the end of a magnet, *i. e.*, its polarity, by colors. In these notes, the character of the magnetism of the *north seeking end of a suspended magnet* is represented by red, and the other end by blue.

6. Permanent and Temporary Magnets.—Hard and Soft Iron.—With reference to its power to retain magnetism, iron is of two kinds, hard and soft. Hard iron when once magnetized remains so permanently. Such a magnet is said to be a permanent magnet. Soft iron is iron which possesses the characteristic of losing its magnetism upon the magnetizing source being removed, or discontinued. Soft iron has another magnetic characteristic to which reference will be made later.

7. Induced Magnetism.—If one pole of a magnet be brought near a mass of iron which is not already magnetic, it will induce, in this mass, magnetism, the character of which is of the opposite kind from the pole which is presented to the mass. For example, if the red end of a magnet be presented to a non-magnetic mass of iron it will induce magnetism in it, and the mass will itself become a magnet, with blue magnetism opposite the red pole presented to it, and red magnetism on the opposite side of the mass. This presents another important law of magnetism which is as follows: Induced magnetism is of the opposite polarity to the kind inducing it. See Figs. 1 and 1 (*a*).

8. Earth a Magnet.—The earth is a large magnet the poles of which nearly coincide with the geographical poles. There is also similarly a magnetic equator, the belt of change from one magnetism to the other, or a belt of no magnetism. This belt exists in *all* magnets and is at right angles to the poles. The poles of the earth attract, or repel, suspended magnets. The magnetism of the earth has also the power to induce magnetism. The direction of the line of action of the earth's magnetism is in the plane of the great circle passing through the magnet poles, *i. e.*, in the magnetic meridian.

9. Color of North Pole of Earth.—In accordance with the law of attraction existing between unlike poles, if we color the north seeking end of the magnetic needle red, the north pole of the earth possesses blue magnetism.

FIG. 1. FIG. 1 (a).

a, a', Inducing Pole.
b, b', Result of Induction by "a."

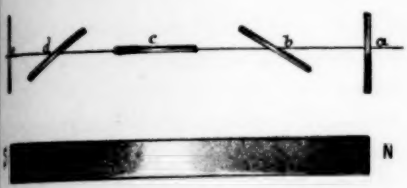


FIG. 2.

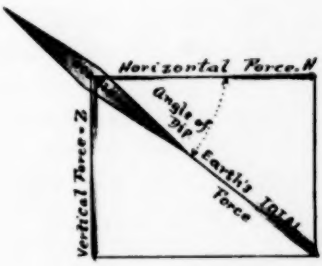
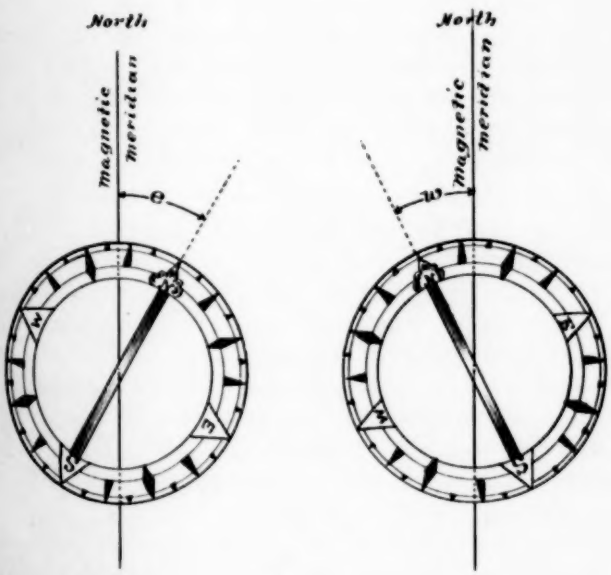


FIG. 3.



FIGS. 4.

e = Easterly Deviation. *w = Westerly Deviation.*

10. **Compass Needle a Magnet.**—The compass needle is a small *permanent* magnet, or a collection of needles acting as one small permanent magnet.

11. **Dip, Horizontal, and Vertical Components of the Earth's Force.**—At the north magnetic pole of the earth, the north seeking end of the needle will point directly downward and the needle will be vertical. At the magnetic equator the needle will rest horizontally. At points of the earth's surface between the magnetic pole and equator, the needle points at some angle to the horizontal. The angle between the horizontal and the direction in which the needle points is called the dip.

This is shown in Fig. 2, where the magnetism of the earth is represented by the large magnet, the position of the small needle being shown at different positions corresponding to different points on the earth's surface.

For a position such as (*b*) in Fig. 2, we have an analysis of the force of the earth as shown in Fig. 3.

The earth's total force, or its horizontal, or its vertical component, is *each* capable of inducing magnetism.

12. **Deviation Defined.**—Under the influence of the earth's magnetism acting alone, the needle of the compass is drawn to point directly to the magnetic poles of the earth, and lies in the plane of the magnetic meridian. Under the influence of other forces opposing the action of the force of the earth alone, such as the action of the iron of a ship, or an artificial magnet of either hard or soft iron, the compass needle is caused to deviate from the vertical plane of the magnetic meridian and to lie in some other plane inclined to the magnetic meridian. The angle between this plane and the plane of the magnetic meridian is called the "deviation of the compass." If the north point of the compass is drawn to the right of the magnetic meridian (facing the north magnetic pole of the earth) the deviation is called "easterly" and is considered positive, if the north pole of the needle is drawn to the left of magnetic north, the deviation is named "westerly" and is considered as being negative. From the above definitions it will be seen that (having a compass heading and knowing the deviation for that heading) easterly deviation must be applied to the right hand, and westerly deviation to the left hand, of the compass heading in order to obtain the reading of the correct magnetic heading. See Fig. 4.

13. Different Parts of Deviation.—For all practical purposes, the total deviation of the compass is composed of three parts; the semi-circular, quadrantal, and constant deviations.

14. Semi-circular Deviation.—The semi-circular deviation is so called because it is easterly in one semi-circle, as the ship's head swings in azimuth, and westerly in the other semi-circle. The points of change from easterly to westerly deviation, or points of no deviation, are opposite each other, and in iron and steel built ships generally occur on those headings upon which the ship rested in building.

Semi-circular deviation is fairly regular, reaching a maximum on points about 90° from the direction of the head of the ship in building. A ship built head north, for example, with reference to its semi-circular deviation, would have approximately 0° deviation on north, increasing to a maximum on east or west and decreasing to 0° on south. If the head were north in building, the deviation will, as a general rule, be westerly for all courses between north, east, and south, and easterly for all courses between north, west, and south.

Remembering the following, one is in a position to investigate the forces producing deviation:

(1) Permanent magnets always act with the same force.

(2) Soft iron, or temporary, magnets vary in the force exerted.

(3) Like poles repel, and unlike poles attract each other.

(4) Induced magnetism is of the opposite kind to the inducing magnetism.

(5) The hard iron in the ship becomes permanently magnetized while building.

(6) The soft iron in the ship has temporary magnetism induced by the earth's magnetism.

(7) We may investigate separately the effect of each kind upon the needle.

15. Forces Producing Semi-circular Deviation.—Permanent Magnetism of Ship.—Let the heavy lines in Fig. 5 represent a ship heading north while building, so that it has assumed the character of a *permanent* magnet, the poles of the ship being of the same kind of magnetism as the poles of the needle, as indicated by the coloring. As the action of the poles of the magnets and of the ship obey the same laws that like poles repel and unlike poles attract, the north or red end of the needle need only be

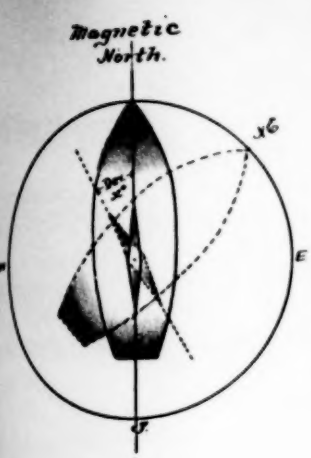


FIG. 5.

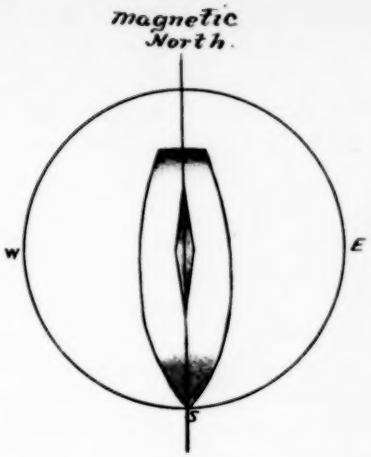


FIG. 6.

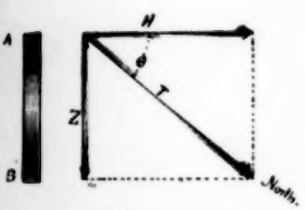


FIG. 7.

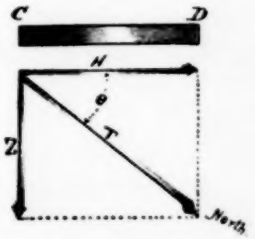


FIG. 10.

T = *total force of the earth's magnetism.*
H = *the horizontal component of T.*
Z = *the vertical component of T.*
θ = *angle of dip.*

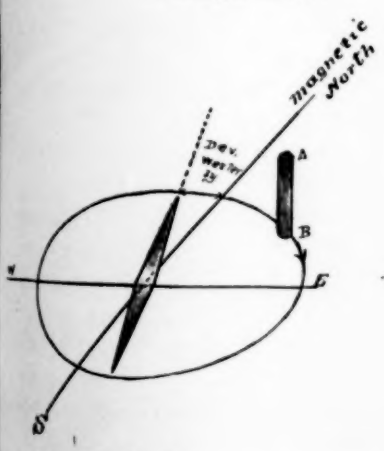


FIG. 8.

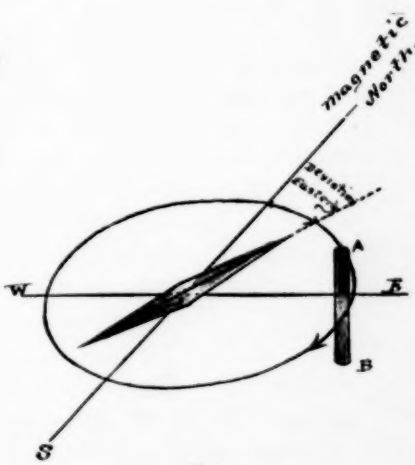


FIG. 9.

considered, the action of the forces on the south poles being entirely in harmony with that of the north pole. In Fig. 5, heavy lines, the north pole of the ship repels that of the needle, but acting through the center of, and in line with the axis of the needle has no deflecting power, consequently produces no deviation, but it does oppose the attracting force of the earth, thus weakening the directive force of the needle. In Fig. 5, suppose the ship to have swung to a NE. heading. The north pole of the ship repels the N. end of the needle and now, not acting in the line of the axis of the needle, has a deflecting power, causing a deviation which increases until the repulsion due to the ship's pole and the attraction due to the earth's force bring the north end of the compass needle to rest in a line coinciding with the resultant of these two forces. This is indicated in the dotted position of the needle. The deviation produced in this case is $x°$ W. on the course NE.

From the foregoing, it is seen that as the ship swings in azimuth from north through east to south, the deviation increases from 0°, reaches a maximum near east, and finally becomes 0° on south; the opposite effect obtaining in the other semi-circle. This portion of the semi-circular deviation is produced by action of the hard iron in the ship having acquired a permanent magnetic character while the ship was building. The remaining portion of the semi-circular deviation is produced by vertical soft iron as follows:

16. Portion of Semi-circular Due to Vertical Soft Iron.—In Fig. 7, let the direction of the total force of the earth be in the line T, θ being the angle of dip. Resolve this into its components, the vertical one Z, and the horizontal one H. Let AB be a *soft* iron bar. The effect of the action of the vertical component of the earth's force will be to induce magnetism in this bar of opposite polarity to the inducing force as shown by the color and ends of the bar. The effect of such a bar on the compass needle is to produce a deviation which is 0° when the bar is in the line of the axis of the needle, and a maximum when at right angles, or nearly so, to the axis of the needle; the deviation produced being westerly or easterly in the eastern semi-circle, depending upon whether the arrangement is that of Fig. 8 or Fig. 9. Study the figures, and note the effect of AB as it moves around the circle.

17. Changes with Change in Latitude.—From the foregoing, it is seen that vertical soft iron acts exactly in a like manner to the

permanent magnet of Figs. 5 and 6, and produces a semi-circular deviation. As this portion of the semi-circular deviation is produced by induction due to the vertical force of the earth, and as the value of this vertical force depends upon the angle of dip, and as the dip changes with a change in latitude, it follows that this portion of the semi-circular deviation will change with a change in latitude.

Summarizing we may say:

Semi-circular deviation is produced by the horizontal component of the settled, permanent, magnetism of the ship, and by the earth's induction in vertical soft iron of the ship. The first portion of the semi-circular deviation is practically constant, the second portion changes with a change in latitude.

18. Quadrantal Deviation.—Quadantal deviation is a deviation which is easterly in one quadrant and westerly in the next quadrant. It is regular in character and is almost invariably easterly in the NE. and SW. quadrants, and westerly in SE. and NW. quadrants. It arises from induction in horizontal soft iron, as will be seen by the study of the following: Resuming the demonstration of Fig. 7, let *T*, Fig. 10, be the direction of the lines of action of the earth's magnetism and, as before, *Z* its vertical component and *H* its horizontal component. Let *CD* be a bar of soft iron, lying in the magnetic meridian, subject to the inductive action of the horizontal component *H*. Then *CD*, while lying parallel to *H*, *i. e.*, in the magnetic meridian, will assume induced magnetism, as shown by its colored ends. Now refer to Fig. 11. Let *NOS* be the magnetic meridian or the line of action of the horizontal component of the earth's force, *i. e.*, the *H* of Fig. 10, and let *CD* be the bar of Fig. 10. If this bar be swung around through 180° either way, in the horizontal plane, that is, from the first to the third position, the magnetism of the ends *C* and *D* will be found to have changed places, that is, the red of the *D* end will be found to have changed to blue magnetism of opposite polarity. See position 3. There is evidently one position between 1 and 3, the point of just changing from one kind of magnetism to the other, at which the magnetism of the bar is neither red nor blue, that is, zero. This position is half way between the 1st and 3d positions, or at 2d and 4th; in other words, a bar held *at right angles* to the magnetic meridian, or to the line of action of a magnetic force, is not magnetized. For positions intermediate between that parallel

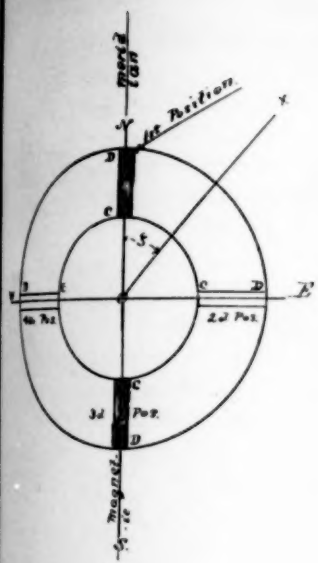
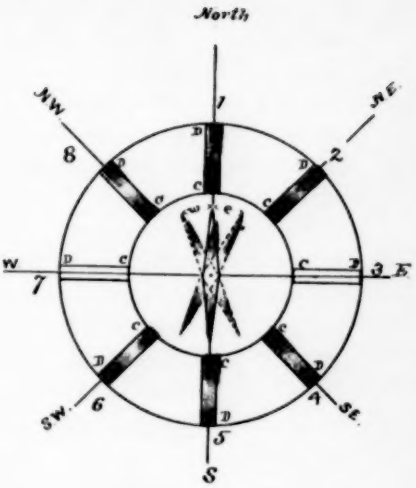


FIG. 11.



e = *easterly*, *w* = *westerly*, *deviation*.

FIG. 12.

FIG. 12 (a).

NOTE TO FIGS. 11 AND 12.

If C D were to extend through the needle as shown in the sketch Fig. 12 (a), instead of being ahead of the needle or abaft it as at 1, or at 5 in Fig. 12, the effect on the needle will be opposite from that produced in Fig. 12, i. e. the quadrantal deviation will be westerly from N to E, easterly from E to S, westerly from S to W and easterly from W to N. This is easily seen by a study of Fig. 12 (a).

to the meridian and that at right angles to it, the amount of magnetism induced in the bar is proportional to the cosine of the angle made by the bar with the meridian. Remembering now that unlike poles attract each other, that like poles repel each other, and that the nearest poles together are the most powerful in effect we are in a positon to understand the action of *CD* when it is swung around a compass.

Referring to Fig. 12, the bar at 1, in the magnetic meridian, is most strongly magnetized but will produce no deviation because it acts through the axis of the needle and in this position has no leverage to pull or push the needle aside and cause deviation. On the contrary, the sketch shows that the magnetism of the bar will attract the needle to keep it in the meridian and will thus assist the earth's force. In such a condition the directive force of the needle is said to be increased.

At 2 the bar will not be magnetized so strongly, but will now act upon the pole of the needle with some leverage, the blue of the *C* end will attract the pole of the needle, draw it to the right and an easterly deviation be produced.

At 3 the bar is at right angles to the magnetic meridian and is not magnetized, hence while the leverage on the needle is greatest, there is no deviation because the bar possesses no magnetic force to act with this leverage. Hence, in passing from 1 to 3 (north to east) the horizontal soft iron bar, under the induction of the earth's magnetism, has produced an easterly deviation attaining a maximum and returning to 0°.

Passing from 3, the ends of the bar begin to take up their new character, and at 4 the red magnetism of the *C* end will attract the blue pole of the needle, pulling it towards it, thus throwing the north point of the needle to the west, producing westerly deviation. At 5, the bar will not produce deviation because of its magnetic force acting through the axis of the needle and thus having no leverage. It will be seen that in this position the directive force of the needle is increased. So, from 3 to 5, there has been produced a westerly deviation starting at 0°, attaining a maximum and returning to 0°.

The same method of analysis shows an easterly deviation from 5 to 7, and a westerly deviation from 7 to 1. It may be easily seen that the maximum deviation occurs near 2-4-6 and 8. See now the definition of quadrantal deviation. See Fig. 12 (*a*) and note to Figs. 11-12.

19. Why Quadrantal does not Change with a Change in Latitude.—The force which produces quadrantal deviation is directly dependent upon the value of the earth's horizontal force and directly proportional to it. The force which acts on the needle to keep it in the magnetic meridian *is* the earth's horizontal force. Hence, as a change occurs in the value of H, the force tending to cause quadrantal deviation and the force tending to keep the compass true, vary in exactly the same proportion. This brings us to the important fact that the quadrantal deviation does not change in value with H and consequently does not change with a change in latitude. For a particular heading, of a particular ship, the quadrantal deviation is the same in all parts of the world.

This may also be proved as follows:

H = horizontal component of earth's magnetism.

ζ = magnetic azimuth of a bar of soft iron. (See line OX, Fig. 11.)

f = coefficient of induction for this bar.

We then have the following:

$H = \begin{cases} \text{Force directing needle.} \\ \text{Also the force inducing magnetism in iron lying in the magnetic meridian.} \end{cases}$

$H \cos \zeta$ = component of H acting to magnetize iron lying at an angle of $\zeta°$ with the magnetic meridian.

$f\ (H \cos \zeta)$ = magnetism induced, *i. e.*, deflecting force.

$$\therefore \text{ Ratio} \frac{\text{Deflecting force}}{\text{Directive force}} = \frac{f H \cos \zeta}{H} = f \cos \zeta .$$

This shows that the ratio is *independent* of the value of H, and depends upon f and $\cos \zeta$. For the iron of a particular ship f is a constant, and for a particular heading ζ is constant.

20. Constant Deviation.—The constant deviation, as its name implies, is constant for all headings. For all compasses symmetrically situated with reference to the center line of a ship the constant deviation is imaginary rather than real and arises from instrumental errors, incorrect readings, misplaced lubber's line, etc. It is always small, and in most cases for compasses situated as above, it is nearly zero. Cases where there is a *real* value of the constant deviation may be found where compasses are not

situated in the central fore and aft line but to one side of this line such as steering compasses at each side of a hand wheel aft.

Correction of the Deviation.

21. **Preliminary.**—If the compass needle is pushed or pulled aside from the correct position by certain magnetic forces, the effect of these forces may be overcome by applying other magnetic forces which push or pull in opposition, and thus bring the needle back to its place as fast as those forces which produce deviation tend to push or pull it out of place. Or, to better express it, if the magnetic forces producing deviation are opposed by equal but opposite magnetic forces, the forces tending to produce deviation are neutralized, and the needle swings in its correct position under the influence of the earth alone.

As has been shown in the preceding pages, the forces causing deviation are those of the magnetism existing permanently, or temporarily in the ship's iron or steel. The neutralizing forces are produced by special magnets, permanent and temporary, placed in positions from which they oppose the forces of the ship and thus leave the compass needle free to point correctly.

Generally speaking, the permanent magnetism of the ship is opposed, or neutralized, by artificial permanent magnets, and the induced, temporary, or transient magnetism, is neutralized by soft iron correctors, so placed that the induction of the earth's magnetism in these correctors is opposite in kind or effect upon the compass from that of the soft iron of the ship itself.

22. **Elements of Correction Considered Separately.**—Just as the effect of each kind of iron on the compass was considered separately, so the correction of each element of the deviation may be separately considered.

23. **Semi-circular.**—Remembering that the semi-circular deviation is composed of two parts, the correction of that part produced by the permanent magnetism of the hard iron in the ship is made by permanent magnets, and that part produced by soft iron is corrected by soft iron correctors.

24. **Correction of Portion of Semi-circular Due to Permanent Magnetism.**—As introductory to this correction, it may be well to consider the expressions "the poles of the ship" and the "poles of the permanent magnetism of the ship."

In Fig. 13 let the coloring represent the magnetic character of a particular ship. All the red magnetism will act together, as a whole, at one point, its resultant or center of magnetism, and this point we will call the pole of the red magnetism. The blue will act similarly as if concentrated at one point, and this point will be the blue pole of the ship. These two points are called the "poles of the ship." For a ship built under the condition shown in Fig. 13, the red pole may be indicated as at P, and the blue pole as at P'. In Fig. 13, the magnetism indicated is that of the entire set of forces of the ship, *i. e.*, of the permanent and transient magnetism combined. We may, however, separate these and investigate either, so that for purposes of illustration Fig. 13 may be used to represent only the permanent magnetism of the ship while we study that portion. In this case, P and P' would represent the "poles of the permanent magnetism of the ship." In Figs. 14 to 19 are indicated the poles of the permanent magnetism of ships built with their heads in the following directions: North, northeast, east, southeast, south, and northwest.

Suppose it is desired to correct that portion of the deviation arising from the permanent magnetism in a ship built, for example, with her head northwest. Fig. 19 indicates the location of the poles of the element of the magnetism it is desired to correct, and it is easily seen that they may be neutralized by one artificial magnet placed as in Fig. 20, or by two such magnets placed as in Fig. 21.

In Fig. 20, known as the *starboard angle method*, one magnet corrects the entire force PP', while in Fig. 21, PP' is considered as resolved into its components in the fore and aft, and the 'thwartship lines, and each artificial magnet corrects one of these components. This is known as the *rectangular method*.

Had the ship's head been northeast in building (Fig. 15), the correction would have been as indicated in Fig. 22.

The magnets used for correction of this portion of the semicircular deviation may be solid, round, or flat, bar magnets, or bundles of small magnets bound together to act as one magnet. In some cases they are placed in specially constructed holders, or trays, in the binnacles; in other cases, they are tacked down to the deck, or secured overhead near the compass. In each and every case, the principles explained in the foregoing are strictly followed, and this element of the magnetic forces of the ship corrected.

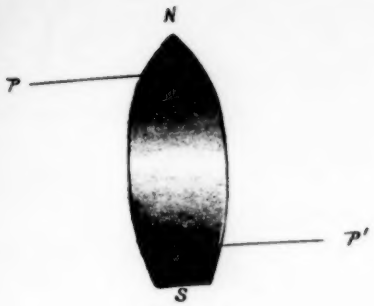


FIG. 13.

FIG. 14.

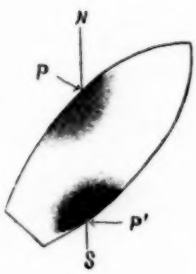


FIG. 15.

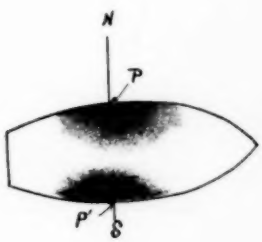


FIG. 16.

FIG. 17.

FIG. 18.

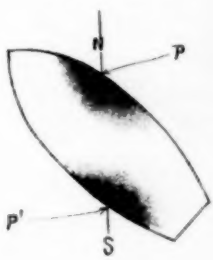
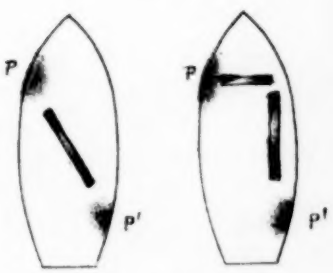


FIG. 19.

FIG. 20.

FIG. 21.



FIGS. 22.

25. **Correction of that Portion of the Semi-circular Deviation Due to Vertical Soft Iron.**—Referring to Fig. 8, it is evident that the effect of *AB* would be neutralized by placing a similar soft iron bar, as at *CD*, Fig. 23. And that the bar *AB* of Fig. 9 may be corrected by a soft iron bar placed at *CD*, as in Fig. 24.

The results obtained by the arrangement of Fig. 24 may be made a little clearer by looking at the needle and bars in a horizontal plane through the needle, as in Fig. 25. Here the blue dots represent the end of *AB* on one side, and *CD* on the opposite side, of the diameter of the circle. Suppose, in Fig. 25, that one position of *AB* and *DC* be chosen. It is easily seen that as *AB*, in moving around the circle attracts or repels the needles, *CD* acts equally in the opposite manner.

Such a bar as *CD*, of Figs. 23-25, is called a " Flinders Bar."

AB, in Fig. 24, could be neutralized by putting *CD* directly over it end to end, but it is to be remembered that *AB* is an imaginary bar representing the magnetism of the ship's vertical soft iron, while *CD* is an actual bar used as a corrector, and is actually placed by the compass. To put it over *AB* would bring it in an awkward place above the compass card, and cause considerable inconvenience in taking bearings, fitting the binnacle cover, etc.

The resultant of the forces which the Flinders bar is used to correct is generally in the center line of the ship, so that nearly all compasses using this bar have it placed in the central fore and aft line of the ship, either forward or abaft the compass; forward, to correct a condition represented by Fig. 8; abaft, to correct the condition represented by Fig. 9. See, again, Figs. 23 and 24.

In many ships this bar is not used, the entire semi-circular deviation being corrected by the permanent magnets of Figs. 20-21. It is easily seen that such a correction is perfect for one latitude only, that in which the correction was made, and that the deviation will change with a change in latitude, because the entire semi-circular corrected by the one set of magnets is, as before stated, composed of two elements, one of which changes with a change of latitude and another which does not change with the latitude.

26. **Correction of the Quadrantal Deviation.**—The quadrantal deviation may be corrected by any arrangement of soft iron which, under the influence of the earth's magnetism, produces a result opposite to that produced by the bar *CD* of Figs. 11 and 12. This correction is generally made by the use of soft iron spheres,

and the action of these spheres will be investigated before proceeding farther.

Let the bar *CD* of Fig. 11 be replaced by a sphere *CD*, as in Fig. 26, and let this sphere be revolved through 360°, taking the successive positions 1, 2, 3, etc., to 8, Fig. 27.

As the diameter *CD* swings around, the character of the magnetism at the *C* or *D* will change, and at 5, Fig. 27, will have become reversed just as was that of the bar *CD* of Fig. 11. The shape of the sphere is, however, such that no matter in which direction the diameter *CD*, Fig. 27, may be, the effect is that of a ball of soft iron, always maintaining the characteristic of having its northern half of red magnetism and its southern half of blue magnetism. In other words, the northern and southern hemispheres are always of the same magnetic character, with their poles north and south, regardless of how the sphere is revolved. The effect is the same as moving around in a circle, parallel to itself, a magnet of the character shown in Fig. 27.

This magnet is produced by the induction of the earth's magnetism, and, if properly placed, its force may be used to oppose the effect upon the compass of other induced magnetism of the soft iron of the ship, *i. e.*, it may be used to counter the effect of the bar *CD* of Fig. 11.

For this purpose, two spheres, one on each side of the compass needle, as shown in Fig. 28, are used. Their action may be illustrated as follows:

Take the position 2 of Fig. 12, in which the ship is heading northeast, and place the spheres in position as they would ordinarily be mounted onboard ship. See Fig. 29. As in Fig. 12, the result of *CD* acting alone would be to pull the needle to the position *e*, thus producing an easterly deviation. The result of the spheres acting by themselves would be to pull the needle to the position *w*, and produce a westerly deviation. The action of the spheres are thus opposed to the action of the bar *CD*, and if the spheres are large enough and placed close enough they may be made to entirely correct the action upon the needle of the bar *CD* or its equivalent.

So far, this explanation has applied to the particular case represented in Fig. 29, but a clear conception of the principles involved, applied to the study of Fig. 30, will show that the spheres oppose, neutralize, or correct *CD* in all positions of the ship's head.

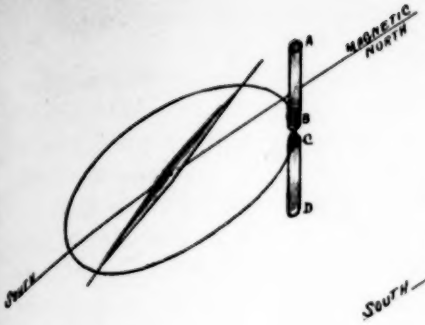


FIG. 23.

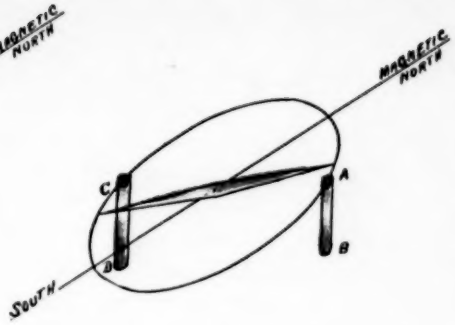


FIG. 24.

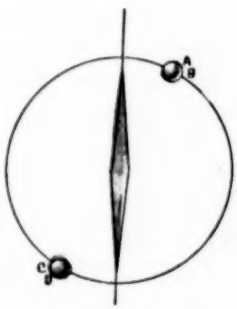


FIG. 25.

FIG. 26.

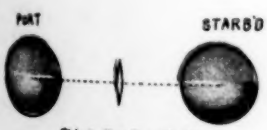


FIG. 28.

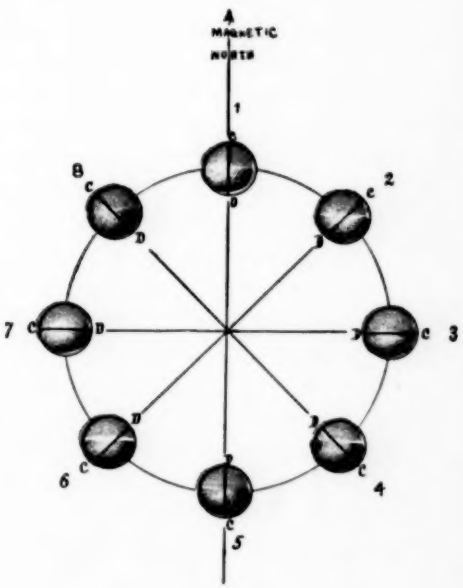


FIG. 27.

The spheres to correct quadrantal deviation, such as would be produced by conditions represented by *CD* of Fig. 12, the conditions ordinarily existing onboard ship, are placed one to starboard and one to port on the 'thwartship line, passing through the center of the compass needle.

If conditions represented by Fig. 12 (*a*) existed, the spheres would be placed on the fore and aft center line of the ship, one forward and one abaft the binnacle. Such conditions are not usually found onboard ships of present construction, so that the quadrantal correctors are usually found one to starboard, and one to port of the compass, and their effect on the compass needle, varied by moving them toward or away from the compass.

In compasses which have large and powerful needles, these needles, when close to the spheres, will induce magnetism in the spheres at the same time and in the same manner as the earth's force. In this case, the quadrantal correcting force is the resultant of the permanent force due to the induction of the needles in the spheres and the variable force due to the induction of the earth in the spheres. The resultant of these two forces is a variable force and when a given quadrantal deviation is corrected in one latitude by this force, the balance will be disturbed and the correction fail to hold good upon going to another latitude. If, however, the needles are so small, and so far from the spheres, as to not appreciably affect them, the quadrantal deviation once corrected should remain corrected, practically, for all latitudes.

27. Heeling Error.—If a ship whose compass has been corrected be heeled to one side, and while so heeled be swung in azimuth, it will be found that the equilibrium of compensation (correction) has been disturbed, and that there now exists on some headings deviations which did not exist when the ship was upright. Furthermore, it will be found that if the ship be brought to an upright position and again swung in azimuth these deviations will have disappeared. The deviation brought into existence during heeling is called the heeling deviation, or heeling error.

In all of the preceding discussion of the causes of deviation, the ship has been considered as in an upright position and the discussion has proceeded on the following assumptions: (1) That such bars as *CD* of Figs. 11, 12 and 12 (*a*) have been in a horizontal plane; (2) that the effect of vertical induction in vertical soft iron, such as *AB*, Figs. 8 and 9, has acted at points other

than directly under the center of the compass needle; and (3) that the permanent magnetism of the ship has acted only in a horizontal plane.

As a matter of fact, that portion of the permanent magnetism which has been considered as acting only in the horizontal plane, has been merely the horizontal component of the permanent magnetism of the ship, and there is yet to be considered that vertical component of the ship's permanent magnetism which acts directly under the center of the compass.

When the ship is upright, this force has no effect in producing deviation. When the ship heels, this force no longer acts vertically beneath the center of the compass but to one side of the compass needle, and consequently in certain positions will produce deviations as long as the ship remains heeled.

This may be illustrated as follows: In Figs. 31 and 31 (*a*), let EF represent a vertical component of permanent magnetism acting directly under the center of the compass, the ship being in an upright position heading north. In this position EF is ineffective in producing deviation.

Now let the ship be heeled to port. The compass bowl will move from K_1 to K_2 and EF will move to $E'F'$. The situation is projected horizontally in Fig. 32. It is evident from an inspection of Fig. 32, that EF, now in the postion $E'F'$, is at right angles to the axis of the compass needle and exerts a pull on it producing, as shown, a deviation of the needle to the high, or windward, side of the ship.

An inspection of Fig. 33 shows a similar result when the ship is heeled to starboard, the deviation of the needle again being toward the high side of the ship, although now of an opposite sign from that in Fig. 32.

In heeling from one side to the other the deviation has changed from easterly to westerly, and if the swing in azimuth, of the needle, synchronizes with the rolling, *i. e.*, heeling of a ship, violent oscillations of the compass card may be produced.

This is one test of the presence of a heeling error, or force producing heeling deviation.

Referring again to Figs. 32 and 33, note that with the ship heading north EF, when the ship is heeled, swings to the side of the needle at right angles to its axis, and is capable of producing on north or south courses its maximum effect.

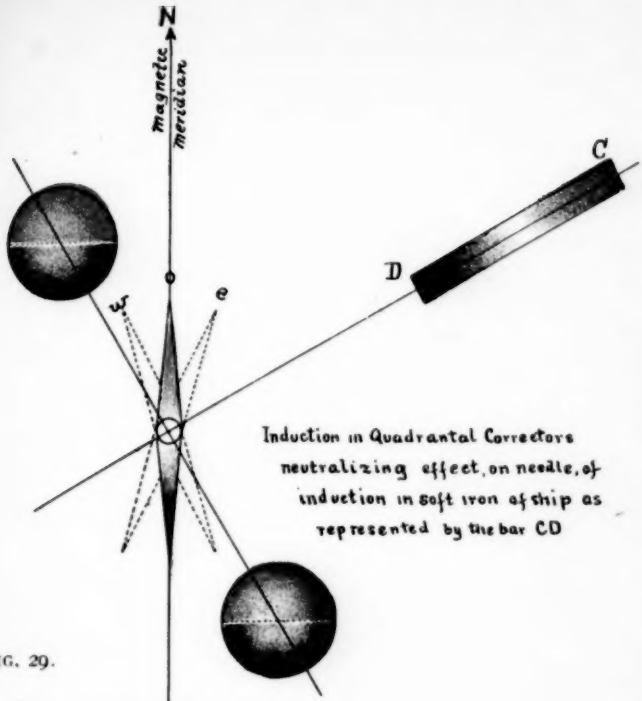

N
magnetic meridian
C
D
Induction in Quadrantal Correctors neutralizing effect on needle, of induction in soft iron of ship as represented by the bar CD

FIG. 29.

Action of spheres as ship swings in azimuth.

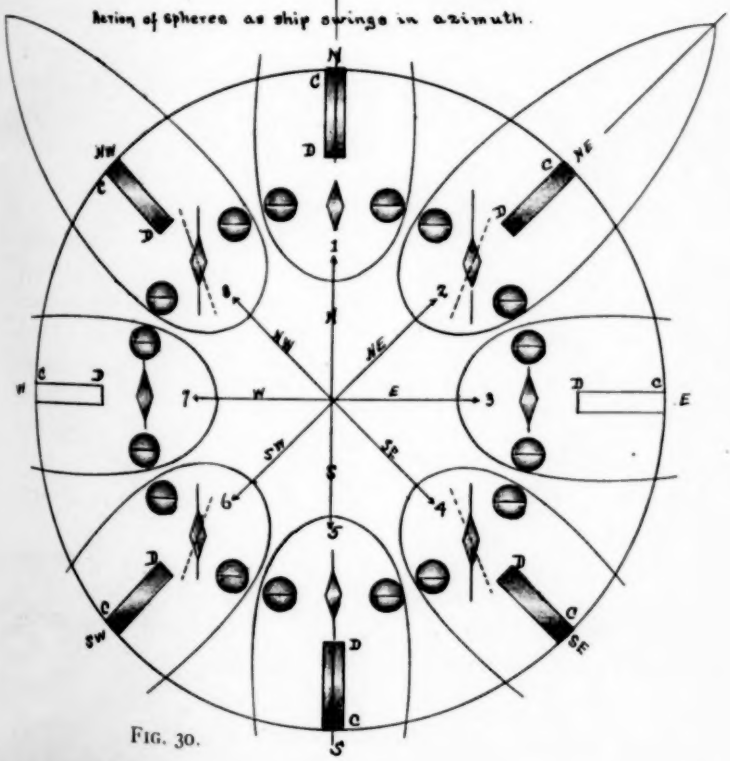


FIG. 30.

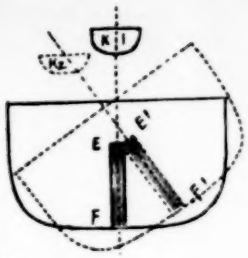
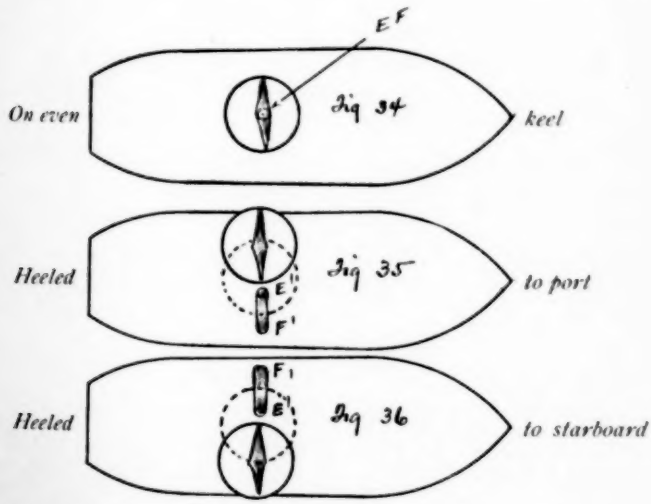


FIG. 31.
Effect of vertical component of permanent magnetism, ship heading North and heeled to port and to starboard.

FIG. 32.
Heeled to port

FIG. 31a.
Upright

FIG. 33.
Heeled to starboard



Effect of vertical component of permanent magnetism, ship heading East and heeled to port and to starboard.

Referring now to Fig. 34, let the ship be headed east on an even keel, and from this position be heeled first to port and then to starboard, as in Figs. 35 and 36.

An inspection of these figures shows that while heeled *EF* may increase or decrease the directive force of the needle, but it acts in the same plane as the axis of the needle and through its center, thus possessing no power to deflect it horizontally. On easterly and westerly courses, *EF* produces no deviation.

This element then produces a deviation semi-circular in character, being a maximum on north and south, and zero on east and west.

28. **Vertical Induction in Vertical Soft Iron.**—If we endow *EF* with the characteristics of soft iron instead of hard iron, Figs. 31 to 36, also illustrate the effect (in north latitude) of vertical induction in vertical soft iron immediately below the compass.

The two forces just considered are, at any one geographical position, so mixed as to make it impossible to separate them.

With reference to the coloring of *EF*, Fig. 31, as permanent magnetism, the upper end may be blue or red, depending upon where the ship was built, how she was heading when built, and in which part of the ship the compass is located.

With reference to its coloring as representing vertical induction in vertical soft iron, the upper end is blue in north magnetic latitudes and red in south magnetic latitudes.

29. **Vertical Induction in Transverse Soft Iron.**—The two forces just considered combine with a third force to produce what is known as the principal heeling error. This third force arises from vertical induction in transverse iron as, for example, the deck beams.

Suppose Fig. 37 to be an end view of a ship heading north (in north magnetic latitude) and *CD* a soft iron deck beam in a horizontal plane immediately below the compass. This beam is, with the ship heading north, magnetic, at right angles to the magnetic meridian, and is not magnetized (see Figs. 11 and 12*a*), and consequently produces no effect on the compass needle which is shown end on at *L*.

Let the ship be heeled to port, as in Fig. 38. This beam now ceases to be horizontal, becomes magnetized, and has a vertical component *DZ*, which is the result of induction in *CD* by the vertical component of the earth's force. This force now acts at

one side of the compass needle, at right angles to its axis, and produces a deviation.

Consider, again, this ship, in Fig. 40, as being upright and heading east magnetic. *CD* now lies in the magnetic meridian, is parallel to the compass needle, and is in the same vertical plane with it. It will be magnetized both in an upright position and while heeled, but lying in the same vertical plane will not tend to move the needle out of that plane, hence produces no deviation. Figs. 39 and 42 represent beams not continuous, *i. e.*, beams in wake of hatches. This force thus produces a deviation which is zero on east and west and a maximum on north and south.

30. Principal Heeling Error.—The combined action of the three forces just discussed causes the principal heeling error.

It is to be noted that they are all a maximum on north and south, are zero on east and west, and are all due to vertical forces. Being due to vertical forces, they are corrected by a vertical magnet placed directly under the center of the compass needle while the ship is upright. They are usually, in a practical sense, considered as one force and corrected by one permanent magnet, so arranged that it may be raised, lowered, or its ends reversed to meet the necessities arising in going from one magnetic hemisphere to the other.

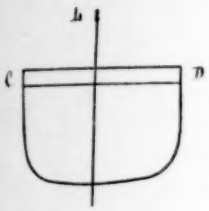


FIG. 37.

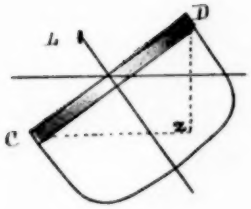


FIG. 38.

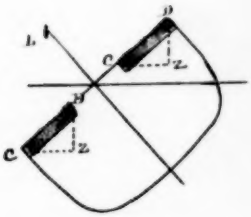


FIG. 39.

Ship heading North. Effect of vertical induction (in North latitude) in transverse soft iron.

FIG. 40.

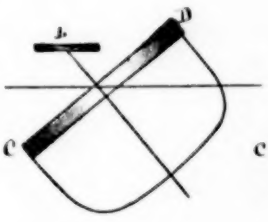


FIG. 41.

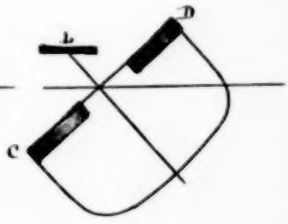


FIG. 42.

Ship heading East. Effect of induction in transverse soft iron. North Latitude.

In connection with Figs. 37 to 40, study Figs. 7, 10, 11, and 12a.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ANNAPOLIS: A FAIR SHOW WANTED.

By LIEUTENANT W. T. CLUVERIUS, U. S. Navy.

The rapid expansion of the navy and the continued policy of keeping a maximum number of vessels in commission is the chief cause of the stress in the course of instruction at the Naval Academy, and scarcely secondary, are the effects of the personnel law of 1899. The latter with its resulting amalgamation, requiring much additional time for the study of both theoretical and practical engineering, being always opposed by the former with its demands upon the personnel at Annapolis to keep the ships manned.

Not only is this tension apparent in engineering, but in ordnance and electricity as well, for these have already far overstepped the allotted portion of the curriculum and both with a wide range of development still ahead.

It is being said in our ships that midshipmen do not know as much as they used to; that they are unable to put theory into practice; that, professionally, they do not acquit themselves with that thoroughness which has so generally characterized an officer of the navy.

This, aside from engineering duties against which these charges are not directed, is in great part true.

And true in an era when midshipmen *must* know more to cope successfully with all that advancement in science has installed upon our ships.

The causes are not obscure. One, of course, is the eliminating of that keen element of competition from Annapolis, and with it the consequent loss of ambition for high class standing. Every midshipman who has attained a satisfactory mark is graduated and every one graduated is commissioned It is no longer a case of one hundred struggling for ten vacancies, and certainly the desire for high standing for its own sake can in no way compare

with it when a commission is at stake. Moreover, midshipmen cannot be expected to realize the effects of such standing upon future promotion.

Yet this cannot be the principal reason, for the caliber of the young men at Annapolis, gathered as they are from the length and breadth of this ambitious land, cannot be materially altered.

Consider another cause: amalgamation has forced into a course of four years already filled to overflowing, the element of engineering which absolutely demands a great deal of time for its comprehension and investigation—its importance is assured in the world to-day and its status in the navy (and, therefore, in the curriculum at Annapolis) is defined by law. With what result? The course is overcrowded. Ordnance, of which a completer knowledge is more essential at present than ever before; electricity, with its gigantic strides; navigation and surveying, with increasing requirements to keep step with our expanding country. All of these, struggling under old conditions to meet the new.

With all this, the cry of more officers to man more ships, cutting down the almost bursting course. For some time, midshipmen have been graduated at the end of three and one-half years, cramming into the last half year what was previously taught in a whole one, losing completely a great deal of the most professional and practical instruction received at any time during the entire course preparatory as this was, to their entrance upon active duties on board ship.

Even under former conditions, when the professional subjects were better covered in section-room than to-day, the daily work assigned was often of necessity long and consequently, improperly assimilated by the average mind and the practical work was limited. What must it be now, with so much more exacted and yet both theory and practice so distressingly curtailed? Is it his fault that the midshipman is not as fully equipped as once he was?

There are those who are proving amalgamation a failure, yet they cannot gainsay the fact that the chief detriment to its efficiency is the lack of time and opportunity available with the young naval officer for the study and practice of engineering. The many who proclaim amalgamation a success must admit this same barrier to present higher efficiency.

The question of time is not as vital in the large engineering schools, however, though it is obvious that, despite the length and

thoroughness of such a course, the graduate is, in no wise, the master of his profession until experience with its practical application, supplements it. In the case of midshipmen time is the retarding factor for both, yet it certainly admits of remedy, and such remedy would be applicable to all other professional branches.

The law has decided that all under-graduates at the Naval Academy shall be taught engineering, and every effort is being made to carry out that law to its fullest extent within the limits of the time allowed.

The shops, the laboratories, the drafting-rooms of the engineering department at Annapolis are completely outfitted and modern methods prevail throughout, the model-room being replete with latest designs of machinery. The possibilities of practical application are clearly outlined. The interest demanded of the student for successful pursuit is unmistakably manifested.

And more time, alone, is needed. With time will come opportunity, and amalgamation, as far as Annapolis is concerned, cannot possibly fail.

Previously, the line cadet actually learned enough engineering to ornament his education. He knew that the outboard delivery, for instance, ought not to be closed down just because there was a boat alongside; that one lone deck-pump could not supply every wide-open outlet in the ship at the same instant; that cinders covered the quarter-deck through accident and not design. Of the practical use of a valve diagram or an indicator card, he had not the slightest conception.

Now, how changed? In the drafting rooms, midshipmen begin drawing machine parts as soon as they can hold their instruments and are at work on valve-gears before the first year is finished. From the vise-bench, through the pattern shop, foundry, boiler shop, machine shop, to the laboratories; there setting valves, calibrating springs, testing engines, operating turbines.

How simply, then, could the success of amalgamation be assured—even to the matter of designing engineers—and with what ease could be met all the growing demands in every branch of a naval officer's profession?

The remedy suggested is this: "A five years' course before commissioning as ensigns with practically the same curriculum as at present maintained; two practice cruises in modern vessels during the course, each of about five months' duration and under the auspices of the Naval Academy authorities."

The expanding of the four years' work into five would necessitate various readjustments and admit of many needed changes.

Taking first the non-professional subjects. Modern Languages, consisting of French and Spanish, is apportioned through the present course, and covers the ground fully enough. English studies require no more time, though certainly could profitably be readjusted to embrace the elements of international law and naval procedure,—for some reason, now lacking. The former is essential, and, as for the latter, how many midshipmen have any but the vaguest idea of conducting a summary court-martial, specifications often being handed to them for delivery their first day aboard ship? It is not their fault, yet the captain's wrath at resulting errors is visited upon their heads.

Mathematics and Mechanics of all departments demand simple expansion. No addition of subject-matter to these all-potent branches required (or desired). An extra year with the present scope would make a wonderful improvement in the application of these subjects in all professional departments: the calculus is treated by the average midshipmen as a *rara avis* when encountered in any but a mathematics section room.

The important factor of electricity in an officer's requirements brings the Department of Physics and Chemistry into the class of professional departments. As it is now, a midshipman is not taught the first principles of electricity until he has been two and one-half years at the Academy. Long before this, he has handled electric primers and fired guns with them without knowing how it was possible; operated searchlights by turning this wheel or closing that switch, absolutely mechanically. Not that there should be less physics or less chemistry necessarily, but unquestionably, more electricity to keep the pace set by that marvelous science, and begin it, too, at least one year sooner.

With the professional departments, the addition of a year would mean as much practically as theoretically. Section-room work could then be interspersed with frequent application, assuring full comprehension of the subject in hand. As an example, in engineering, the working model would supplement the text-book description; or in navigation, the extended practice with the sextant, would solve any question of adjustment.

The fifth year would furnish one more year of drill and prac-

tical instruction—welcomed by all these departments, especially if a modern armored vessel and several destroyers were permanently attached to the station, vessels whose batteries and machinery may be entirely disassembled, if desired, for the better instruction of midshipmen, and not kept standing by for a gale of wind at all times.

Seamanship wants more time on the water, it has enough section-room work. So with navigation. It needs more actual work with the sextant and the compass. Of course, much practical work in navigation is obtained on the summer cruises, though these are so short, and changes from ship to ship so frequent, that best results cannot be gained. Useful, also, would be practical exercise in harbor surveying: how many young officers to-day could, without preparation, make an expeditious survey of a harbor?

In Ordnance, thorough knowledge of the ordnance material, varied as it is, and of its care and manipulation, is a positive requirement. This is the day of the hitting-shots, nothing else counts, and to attain this, practical ordnance should extend over every year of the course at Annapolis, with ample provision for target practice with great guns, small arms, and torpedoes.

The Department of Marine Engineering includes naval construction. Enough of this subject is taught all midshipmen to make them familiar with the types and construction of our ships. Excellent models are available and, if need be, a post-graduate course could easily be established for those selected for the construction corps.

To a great extent, the solution of the question of amalgamation—a success or a failure—remains with the Engineering Department at Annapolis. More time, more time is the cry there, with its magnificent plant. With what time there is, results are already gratifying and marked co-operation exists between student and instructor. Still the field of engineering daily is widening its borders, and the allotted hours for research do not permit Annapolis to keep in the van where it had been for decades.

Thus it is: more knowledge constantly imposed and less time as steadily allowed in which to gain that knowledge.

Surely one years' more instruction will help greatly. The midshipmen would be commissioned in five years instead of in six. The effects of the present method of cutting down the four years'

course is to commission him only about three months before the time defined by law. He still does his two years at sea before commissioning, performing the same duties then as later, when an ensign.

What has the midshipman gained? Nothing; he has lost. He feels it, his seniors feel it. Nor has the Navy Department gained. One more officer aboard a ship, yes; but does he add one more officer's worth?

Now with the five years' plan—a plan in which the government gains a year's time. The present three short practice cruises aggregate eight months, each cruise split up among various ships comprising the squadron for that cruise, scarcely enough time to get acquainted with one's shipmates. Substitute two cruises, one near the beginning and one near the end of a five years' course. Vessels from the Atlantic Fleet or from the reserve list could readily be prepared for this duty—slight changes in outfit alone being necessary. Or better yet, enough vessels attached to the Naval Academy the year round to accommodate the entire body of midshipmen for the practice cruise. In either case, officers on duty at Annapolis to be in charge, so that a uniform system of instruction and discipline will obtain. Then, in these five-month cruises, with their uninterrupted opportunities for actual experience, in ordnance, engineering, navigation, electricity, seamanship—target practice—what gain will be the midshipman's, and what the government's? Surely more than the simple year's time, and certainly a gain for both.

These, together with the accrued benefits of the more nearly complete absorption of the curriculum at Annapolis, must needs insure the efficiency of the entire newly-commissioned personnel of the navy.

Then, too, as far as amalgamation is concerned, the Navy Department surely cannot fail to perform its share of the contract under the law of 1899 and insist that the graduates of the United States Naval Academy be given every chance to utilize their splendid equipment in marine engineering.

Then if the law stands, it will thus receive a fair test—and its adherents can well be sanguine.

It is submitted that with some such change in the course of education of the midshipman, his value to the service would be decidedly enhanced and his standing in his chosen profession unassailable.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SUBMERGED SALT WATER STORAGE FOR COAL.

By CAPTAIN W. H. BEEHLER, U. S. N.

The great expense and anxiety due to fires in coal sheds makes the advisability of submerged storage for coal very important. At Key West and Dry Tortugas, Fla., 35,000 tons of coal have been stored in four large steel coal sheds—two at each place—with about 6000 tons in four old wooden coal sheds. The coal in these four steel sheds has been stored at depths varying from twenty to thirty-five feet, and this pressure has necessarily generated fires in the coal.

At Key West there was one cargo of 2600 tons of coal, received last September, which contained a very large amount of crude sulphur. This ship, *Evelyn*, had been engaged in the sulphur trade last summer previous to taking this cargo of coal.

Fires broke out in this coal about a week after the coal had been stored in the shed; and these fires, instead of coming from the bottom of the coal pile where the pressure was greatest, were found to be in the upper strata of the coal in the shed. It was necessary to remove the *Evelyn's* entire cargo in the process of fighting the fires. In this removal large lumps of sulphur were found, and it is estimated there must have been ten to fifty tons of crude sulphur in that cargo.

To fight these fires a long patent drive-point nozzle was used, and at one time seven streams of salt water were being pumped into this shed and men were employed day and night to fight the fire. The *Evelyn's* cargo had to be entirely removed from that shed. It was placed in lighters and on the pier, and has gradually been expended, while the sulphur has probably all been consumed.

Fires in other parts of this coal, and in other sheds, have also broken out from time to time, and these have been extinguished

largely by the use of a patent drive-point nozzle. This nozzle is arranged to couple with an elbow having a large anvil head that can be hammered, and it is fitted with a valve. The rest of the nozzle is a pipe in sections of about six feet long, so that it can be lengthened up to thirty feet. At the lower extremity of this nozzle there is a drive point, which is simply a cone inserted at the bottom to give a sharp point. A shoulder in the pipe prevents the point from being driven up. The point, however, drops out when the pipe is withdrawn from the pile, and this point is lost. The object of the point is to facilitate driving the nozzle into the coal without choking the pipe with coal. The hammer head at the coupling of the hose affords an anvil which can be hammered to drive the point into the coal, and the nozzle then penetrates and permits the water to be applied to the fire.

In trying to put out a fire by means of a stream of water, the water flows around on top outside, and does not reach the seat of the fire, as a rule.

It seems that the pressure of the weight of the coal causes gases to be evolved, especially in little pockets where lumps of coal bridge over air spaces. The air in these small pockets causes combustion of the gas there, and fine coal around is probably fused to form an arched furnace. As this proceeds the coal is coked and the furnace gradually enlarges. Smoke and gas escape through crevices in the coal and form the only indication of the existence of such pockets of fire in the mass of the coal.

Such a mass of coal is a bad conductor of heat, and temperatures by thermometers in temperature tubes give no indications of the site of a fire.

In these coal sheds there are a great many temperature tubes and ventilating pipes, and thermometers placed therein give the temperature in those pipes. These temperatures are taken constantly, but they give no indication of a fire or of any great heat except right there in those pipes.

We have had fires five feet away from one of these pipes, and there was no evidence given by these temperature tubes whatever that there was any abnormal heat in the coal pile.

All these temperature tubes and ventilating pipes are rather expensive fittings, and of no use, but rather a source of danger, in that they contribute to form these pockets of combustion in the coal. When coal is placed in the shed the big lumps fall down

to the sides, and these big lumps bridge over air spaces, where the pockets of combustion have always been found. These temperature tubes and ventilating pipes also provide places where lumps of coal bridge air spaces and form pockets of combustion, and it is only when a fire develops close alongside one of these ventilating pipes that the temperature there shows fire. These ventilating pipes also afford an escape for the gases which are pressed out of the coal.

These gases constitute the chief and only value of coal, in that they furnish the heat units, and their escape from the coal represents a loss of so many heat units from that coal.

Therefore, the use of these ventilating pipes is not only dangerous, but should they not cause a fire to be generated, they deprive the coal of its value in heat units. These ventilating pipes are also very expensive and should all be removed. They do not give access to the fire to extinguish it, but only promote combustion. When a fire is generated, smoke will find exit and indicate that there is a fire. This smoke, however, does not always appear directly over the seat of the fire, but finds its exit in a devious path, at times as much as ten or twelve feet to one side of the fire.

Upon such evidence of fire the patent drive-point nozzle has been used and water has extinguished it. It is frequently necessary to use three or four such nozzles, though in this soft bituminous coal the drive point feature has not been found of much use—simply using the pipe suffices. By using four or five such long pipes in a space within ten square feet of the point where the smoke appeared, the seat of fire has generally been reached, and water has invariably extinguished the fire.

There is no doubt that water will aways extinguish a fire, provided the water can be applied at the site in sufficient quantities. The old idea that water caused spontaneous combustion has been thoroughly exploded. Chemical decomposition might be caused by fresh water, in that fresh water will dissolve some vegetable matter, and those chemical solutions thus formed may contribute somewhat to the formation of solutions that would cause fire. But this cannot be true of water in contact with coal. Salt water will not dissolve coal and liberate the gases that would develop heat. There is no possibility of spontaneous combustion from water, whether in minutes quantities or by flooding.

Water will extinguish coal fires, and coal kept in water cannot burn until the water is removed.

If the coal is kept under water, it is evident there will be no combustion of the coal.

The British Admiralty experiments with the submerged storage of coal have not been concluded; but indications here at Key West point out very clearly that it will be of great advantage to have coal stored under salt water.

There is no reliable data of a scientific character to demonstrate that fact, from the experience here at Key West. Coal that dropped from the coal sheds into the sea water around the coal sheds has been removed and consumed in the boilers of the distilling plant. It is not known how long that coal had been submerged under salt water, and the only point positively ascertained was that the coal did seem to burn better in the boilers of the distilling plant than similar coal which had not been submerged. This was only the opinion of the firemen at the boilers. There were no accurate measurements taken as to the combustion of this coal, the heat units evolved, the products of combustion, and comparative value; but it was evident that this coal, after having been submerged for at least a year, was as good as the coal which had recently been brought here. No deleterious effect was observed upon the boilers by the use of this coal which had been a long time submerged in sea water.

The coal in the coal sheds has been saturated with water, especially that in the same shed with the *Evelyn's* cargo, and from all that can be ascertained, this coal has not been in any way injured by having been saturated with salt water. The *Evelyn's* cargo, which contained a good deal of sulphur, and consequently, after the fires, had a good deal of coke, has been consumed, and the rest of this coal that is here now will be watched to see if it has suffered by having been saturated with salt water.

Fires generate here in the tropics from coal every winter. The coal which is in the old wooden coal sheds at Key West, stored nine feet high, has recently been on fire, and it was necessary to employ the patent nozzle, which extinguished it. This coal is all kept under roof, in order that the escape of gases may be prevented.

It is claimed that if a ton of fine bituminous coal be spread out on a concrete pavement and exposed in open air in this climate

for one year, it will lose all its calorific properties. The gases are simply free to evaporate from the coal, and when the coal has lost all its gas it will have lost all its heat units and be simply coke.

In a coal pile, the top surface of the coal in this climate becomes practically burned out. The gas from the upper layer has been free to exude or evaporate by the action of the sun and the atmosphere, and it is only because the upper layers of coal cover the mass that the mass retains any of its heat units.

From this it is evident that if covered by salt water the gases cannot escape from the upper layers. All the gases will be practically retained in the mass of coal. There is no loss of heat units while stored under water.

The salt water storage will obviate all loss of coal due to dust. The fine coal dust will not be blown away, and it is a very conservative estimate that at least fifty to one hundred tons of coal have been lost in the shape of dust in handling the fifteen thousand tons of coal in one year at Key West Naval Station.

During the past six months I have been making a careful study of this subject, and I have recommended that the steel coal sheds shall be converted into concrete water-tight cisterns, having the same coal hoisting machinery as at present, but merely lined with concrete walls, with sloping sides, and inverted pyramidal bottom, fitted with drain-pipes at the bottom to drain off the water when necessary, and also to have means to flood it with water. Such a water-tight concrete cistern would store the coal, and should have no dangerous ventilating pipes or other aids to combustion. By having an inverted pyramidal floor the grab buckets can be used to remove all the coal without hand labor to load skip buckets.

The advantages of such a water-tight concrete coal shed are as follows:

(a) The submerged storage of coal therein will hermetically seal the gases in that coal.

(b) Small pockets of combustion cannot be formed with that coal under water.

(c) The gases cannot be evolved from the coal under water.

(d) The pressure upon the particles of coal at different depths will not be so great. The pressure at the bottom will not develop heat, because the pressure in a reservoir of water fifty feet deep does not generate any heat at the bottom of that reservoir by the weight of the superincumbent mass of water.

(e) Fires in the coal stored under water are impossible.

(f) The expense of fighting fires during the past ten months at Key West would more than defray the cost of converting that shed into a concrete water-tight cistern as proposed.

(g) The evolution of gases in the sheds at present has a very deleterious effect upon the steel work and makes it necessary to paint these sheds much more frequently than iron and steel structures are otherwise required to be painted.

(h) Such submerged storage will obviate the loss of coal by fire.

(i) Coal so stored will be delivered damp, and there will be no loss of coal dust carried away by the wind.

(j) In such a concrete water-tight cistern the wet coal will not come in contact with any steel work, and there will be no corrosive action upon steel work by the salt water not in contact.

(k) In fighting fires at present, streams of salt water are poured in upon the fires, and this salt water has a very deleterious effect upon the steel framework of the shed, which would not be the case when no fires are generated.

(l) Coal delivered to ships from such a concrete water-tight cistern would be damp. It could easily be arranged that shortly before delivery—one or two days, perhaps—the water could be drawn off from the upper part of the coal shed to deliver the coal without water, when the coal would simply be damp, and not dusty.

The foregoing advantages of submerged salt water storage appear to me to be incontestable, and the disadvantages are merely supposed deleterious effects of salt water and difficulty in drying coal that has been long saturated with salt water.

It is claimed the wet coal will injure the bunkers of ships, but the Navy Department has recently authorized wet coal to be delivered to ships, and therefore this objection cannot be sustained. Coal is just as wet from water used in extinguishing fires as it would be if kept constantly submerged under salt water, and the objection of having wet coal in the bunkers can be ignored. The very slight corrosive action of damp coal in the bunkers of the ship is of no importance compared with the exposure of the outer skin of the hull of the ship floating in salt water.

The effect of burning coal pickled in brine in the furnaces of modern boilers may possibly be injurious to the tubes; but that

effect, at the worst, can only be very slight, and it is exceedingly doubtful if the products of the combustion of such coal which had been for years stored under salt water could have any deleterious effect on the boiler. It would take many years for coal submerged under salt water to have such quantities of chloride of sodium or other chemicals as to be injurious in a boiler.

In view of the removal of the coal depot from Dry Tortugas, it would seem that this would be a most opportune time for the re-erection of these coal sheds after their removal, with provision to fit them up as concrete water-tight cisterns.

The extra expense of constructing such water-tight cisterns for coal sheds in a tropical climate will be more than covered by the expense due to fires, loss of coal, gas, etc., in one year.

The Navy will suffer a great loss by being deprived of the coal depot at Dry Tortugas. But that is certainly an ideal spot for a national quarantine station and a place of refuge against yellow fever, because of the absence of mosquitoes at Dry Tortugas when mosquitoes are very thick on all the other keys of the Florida reefs.

Coaling depots are absolutely necessary for a fleet, and it is a narrow-minded view which claims that they must necessarily be protected by fortifications. Coaling depots certainly need protection, but that protection can only be afforded by the fleet itself. The Navy must have command of the seas, and coal is essential to the Navy. If the Navy has not command of the seas the coal is not needed at all.

But if the country demands the Navy shall give up the coal depot at Dry Tortugas, it is urgently necessary that the coaling facilities there should be transferred to Key West in order that this most important strategic point may be properly utilized. These coal sheds and the two piers can all be taken down and re-erected at Key West, along the deep water-front, along the line running from Fort Taylor north to the present coal sheds. These piers in front of two additional coal sheds would be on the line of the quay wall to Fort Taylor, where the channel has thirty feet of water. The improvements contemplated at the Key West Naval Station will readily facilitate the erection of two additional coal sheds at that point.

The projected utilization of Fleming Key in Key West harbor as a torpedo destroyer depot makes it essentially important to

have greater coal storage facilities at Key West, and at least as much additional as has been stored at Dry Tortugas.

The extension of the Florida East Coast Railroad to Key West (which will be in operation in February, 1907), greatly enhances the strategic value of Key West and emphasizes the urgent importance of not reducing the coaling facilities of this region by removing the coal depot from Dry Tortugas without re-erecting the same at Key West.

The argument of some, that the railroad along the Florida reefs will be exposed to destruction by an enemy's fleet, is absurd. The communications of an army in the field are always liable to attack by a flanking raid by the enemy; but the communication is not any the less valuable because of such a possibility. No one would think of removing New York back into the interior because it might be bombarded by a fleet off Coney Island, and the only wise defense of exposed points on the coast (and, in fact, the defense of the country itself) lies in having a navy thoroughly well prepared and adequate to command the seas. A raid by a cruiser might do some damage, but the damage caused is always in proportion to the strength of the force that makes the damage, and the repairing facilities of a railroad in operation are so great that any damage done by a cruiser to a railroad along the Florida reefs would only cause a temporary interruption, provided the strength of the squadron at Key West was as adequate as it should be. A few torpedo-boats and submarines at Key West would give adequate protection to the railroad along the Florida reefs, in cooperation with the battle fleet.

It would be very desirable if it were possible to ally the navy with the merchant marine as closely as is the case in Germany. The German navy does not need coaling depots in different parts of the world, because the German merchant marine provides the German navy with coaling facilities all over the world. It is a law of the German Empire that all German merchant steamships and steamship companies must at all times place their ships, supplies, and everything, at the disposal of a naval commander, so that in case any commander of a German naval vessel should want coal he may take it from the German steamer or the steamship's coal depot at Hong Kong or any other place, upon his receipt, and the German Admiralty will reimburse the steamship owners at the cost of the same, and the German Admiralty is the final

judge as to the amount of compensation that shall be paid to the private steamship companies. Claims for constructive or consequent damages by the government taking such private property of German steamship companies will not be entertained, and therefore the entire German merchant marine and all the resources of the German merchant marine are practically under the control of the German Admiralty whenever the German Admiralty wishes to take advantage of this law of the empire.

The German government does not subsidize its vessels, but this absolute control of all the property of private German steamship companies, in war and in peace, is better than any subsidy that could be devised.

In the absence of such a close alliance of the United States Navy and its merchant marine, it is absolutely necessary for us to have coaling depots. They need not be defended by elaborate fortifications, if we have a navy adequate to command the sea.

Owing to the condition of the coal mining industry, by which in one year there may be ample coal available from coal mines, and in the following year there may be a coal famine, it is highly important that there should be at least one depot in the West Indies—at the place of the greatest strategic importance, Key West—where coal could be stored for years, and by which we could, like Joseph in Egypt, be prepared for coal famines in the future.

The writer begs to state that the foregoing paper is the result of his experience with the storage of coal at Key West and Dry Tortugas, Fla.

He does not claim to be infallible, and it is possible that some features in regard to the storage of coal have been overlooked and that a discussion of the subject will reveal the true solution of the problem.

The results of the British Admiralty experiments are being urged as necessary before we should undertake to solve this problem. But it is not wise to count upon getting all the information from the British Admiralty. It is clearly our duty to find these things out for ourselves, and it is possible that the British Admiralty may not care to divulge the knowledge they will obtain from their experiments. Therefore it would seem to be wise for us to provide for salt water storage for coal in any new sheds that may be erected. Money has been appropriated, and is avail-

able for building an additional coal shed here at Key West, and it would seem to be a simple matter to arrange this new shed for salt water storage by having concrete walls. This shed could be built with such concrete walls, and without the expensive fittings of ventilating pipes, etc., that I believe to be not only unnecessary, but also dangerous aids to combustion. Such a shed could be also used to store coal dry if salt water storage should be undesirable, and such a shed with concrete walls will have an advantage in keeping the mass of coal cooler than in the present style of shed with black steel walls. These black steel walls absorb the heat of the sun, which contributes considerably to increase the temperatures of the coal in the shed.

Here, then, is an opportunity to make this experiment without much, if any, additional cost. Surely one of the most practical elements in our preparedness for war is to have an ample supply of coal, and if we could store coal for years without detriment, the Navy could then be independent (in the case of threatened war, or in the first outbreak of hostilities) of coal strikes, etc., which at times make it difficult, and even impossible, to obtain any coal.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN ANSWER TO CRITICISMS OF "IS AMALGAMATION A FAILURE?"

By LIEUTENANT-COMMANDER L. H. CHANDLER, U. S. Navy.

After reading the discussion of my essay on this subject, I find but one point on which I wish to touch, and that is in regard to a phrase current in the arguments of the anti-amalgamationists. This phrase is that "specialization is the order of the day," which wise saw is generally backed up by some such statement as "When I have trouble with my eyes I go to an oculist, and not to a general practitioner" (regardless of the fact that when at sea they do no such thing, but do go to the general practitioner detailed as medical officer of the ship). The argument along this line generally ends at this point, and no method of organization is suggested which would supply these specialists.

I am a thorough believer in specialization for the higher branches of any kind of scientific work wherever it is practicable, but I do not see how it is possible aboard ship. If the argument as given applied logically to ship life, instead of having a medical corps of general practitioners we would have medical officers, oculists; medical officers, aurists; medical officers, throat specialists; medical officers, physicians; medical officers, surgeons (with separate ones for each particular operation, as we have ashore); and "many others, too numerous to mention." We should have pay officers for pay, pay officers for clothing, pay officers for food, etc. We should have chaplains, Episcopalian; chaplains, Methodist; chaplains, Baptist; chaplains, Roman Catholic; chaplains, Presbyterian; etc., one of each "special branch" aboard each ship. We should have marine officers for infantry, marine officers for great guns, marine officers for field artillery, etc.

Let us see to what this would lead in the duties performed by

the present line, and in so doing we must bear in mind that we must have aboard ship enough officers to do the duties in each branch and to allow for sickness, for accidents, and for casualties in action. Specialization carried to its logical limit, according to the customs prevailing ashore, would call for something like the following number of officers and corps aboard each battleship:

Corps.	No. of Officers Needed.
Command corps	4
Executive and deck corps	10
Navigation corps	4
Compass corps	4
Ordnance corps	4
Torpedo corps	4
Electrical corps	4
Wireless telegraph corps	4
Signal corps	4
Gun division and turret corps	20
Fire control corps	10
Boiler corps	10
Steam engine corps	10
Total—13 corps	92 officers.

Guess at the total number of officers and corps and continue to split up your specialties for yourself (as the much quoted medical fraternity does ashore), and continue the process "ad nauseam." And remember that a specialist in any one branch cannot, according to the argument, possibly be fit to do any of the duties of any other branch, and therefore cannot be promoted to any other. How many hours a day would each have to spend in his "specializing," and what would he be doing the rest of the time? Where would they all live?

Why not, as suggested above, specialize for command duty from the beginning as well as for any other branch? The other officers have to waste a lot of time on details that it is not at all necessary for the commanding officer to know, such as how to run or repair a dynamo. Why should he waste time on such things; why not begin his study of command duties as a specialty in his early days as is advocated in the one branch of steam engineering?

Boilers and engines are two very different specialties, as shown by the protest that went up when the department ordered that

water tenders should be promoted from firemen through the grade of oiler only. Loud and long were the protests against this, and they prevailed.

And what kind of harmony would prevail aboard a ship loaded down to the guards with the necessary great number of one-sided, specialized freaks? The pandemonium that would result would make the old line-engineer bickerings seem like the billing and cooing of turtle doves in comparison. And in case the compass officers should give out, imagine the attitude of a navigating lieutenant asked in the emergency to descend from the heights of his studies in the heavens to the vulgar details of keeping the compasses in order. The hauteur of the Japanese butler requested to perform some of the duties of the second boy would be as nothing in comparison.

And, by the way, to descend from the "jest spoken in sober earnest," why do the ardent advocates of specialization apply their arguments to steam engineering only? Compared to electrical and ordnance appliances in all their branches, steam engineering, even with the near advent of the turbine, is a finished science, while the others are in their infancy. The progress made in steam machinery in the past few years, great as it is, is as nothing compared to the advance in the other branches and is in practical details mainly and not in theory. Why is there no howl for specialization in them? *Because those high sciences came into being under an amalgamated system, and grew under that system by leaps and bounds that have made the advances in steam engineering seem slight in comparison.* Amalgamation is not a failure in these, for the pudding that furnishes the proof has been eaten and digested with satisfactory results. The steam engineering pudding has also been swallowed, and, while it is just at present disagreeing with some of the weaker stomachs (this will soon be over, on the "kill or cure" principle) the stronger constitutions are thriving on it, and we will soon hear no more on the subject.

The English navy, a number of years ago, worked on the extreme specialization principle, and has been getting over it just as fast as it possibly could. The English started a long way behind us, however, with their "navigating lefftenants," etc., and who is there that has not heard the numerous service yarns spun daily within as short a time as ten years ago as to the work-

ings of that system. The one that sticks in my mind at this moment is of the English ship at Montevideo, under rush orders to sea, whose navigator died, and, as a result the ship could not go to sea until another had been brought down from the fleet at Rio. These stories are familiar to all our older officers and to many of the younger, and, although the details may be exaggerated, they represent well the conditions that existed under such a system of specialization; a system, by the way, which would be as the densest amalgamation, compared to that to which our present day "specializationists" would lead us if they dared be logical.

As the modern battleship herself is a compromise, owing to there being a limit of possible weight, so also must her officers be compromises, owing to there being a limit of room. The very people who use the argument of the medical officer forget that aboard ship that officer is not a specialist, but (as we can only carry a few doctors) must know how to care for and keep efficient all parts of the human mechanism. So also must the line officers know how to care for, keep efficient, and handle all the mechanical parts.

In addition to the discussion published in the Naval Institute there appeared, at about the same time as my paper, two articles on the same subject, and in these two are found more arguments against my view than in the discussion. I therefore desire to give here some few remarks in regard to each of these papers.

The first is an article published in the *North American Review* for March, 1906, entitled "Our Navy," which claims to have been written by "An American Citizen." As this citizen conceals his identity by what would seem from the nature of the article to be a somewhat unnecessary anonymity, it is impossible to judge what his opportunities for observation may have been, or whether he is by education or training competent to pass upon the matters under discussion, and (as in the case of all anonymous papers), a doubt is cast upon the information and knowledge upon which the arguments are based, and consequently upon the value of the conclusions reached.

The paper is, however, apparently a strong one, in that it praises those who hold the opposite view, is mild in tone, and appears to have been written in a judicial vein. The fallacies in the argument are apparent to the student of the subject only, and not to the casual reader.

There are but three criticisms of this paper that I wish to make, and in the first two I try to repeat the same words in which another officer expressed them to me. They are:

1. The paper argues that naval officers are so efficient, so honest, so zealous, so intelligent, and so capable, and so wrapped up in their profession that they should not be allowed to administer the higher offices of the navy without being diluted by a very considerable proportion of civilian inefficiency and lack of interest in and familiarity with the subject.

2. The first half of the paper argues that special knowledge is not necessary, and is indeed an inadvisable quality to be possessed by the higher officers who are to administer the navy, while the second half argues that for younger officers, and for those who are to run ships and fleets, only specialists should be employed. This author, like all the rest, fails to say how far he would carry this specialization.

3. The article reads between the lines as an argument in favor of civilian control of the administrative details of the navy and of the establishment of a corps of non-sea-going civilian steam engineers.

The second paper, and it is a very important one owing to the high standing and character of its author, is by Rear-Admiral Stephen B. Luce, U. S. Navy. The high esteem in which Admiral Luce is held by all makes us give great weight to his views, but, nevertheless, it is possible that in this case his judgment may not be sound. He retired in March, 1889, never having served aboard a modern war vessel.

In estimating the value of his judgment on this point, we must consider the degree to which he has shown himself progressive on similar subjects in the past, and to do this we can do no better than to consider his course in regard to the replacing of sail by steam in the days when that controversy was raging hot. If he was progressive and correct in his views then, we can give great weight to his views now, but if he was ultra-conservative and wrong at that time its casts grave doubt upon his arguments of to-day.

In the second edition of his "Seamanship," published in 1863, he prints on the blank pages preceding his preface, the following extract, which is thus made the text from which the book is written:

" . . . . The battle over, the fleet must or should pass from steaming to sailing, in order to economize fuel, which may be wholly or nearly exhausted during the action, the like expenditure of fuel may have taken place in the enemy's fleet, and this, together with the dismantling effects produced upon the rigging of his ships, will impede or prevent his escape. Both sailing and steaming power, in the same ship, must therefore be always kept in a state of efficiency. In the early days of steam propulsion, it was imagined by Paixhans and others, that a few small steamers, with little or no sailing power, might destroy or capture any ship if properly attacked on her weak points, and this is true in calms, and of operations in inland seas and waters, in which fleets of large ships of war can neither manœuver, nor follow vessels of small draught of water into shallow creeks or channels. But for steam warfare on the ocean, ships must be rigged and equipped with full sailing power, and, consequently, fully manned with able seamen as before; and thus, nautical skill and good practical seamanship will be as necessary as ever to steam fleets, *and will continue to tell, as heretofore, in favor of that party which is most proficient in nautical skill and expert seamanship.* It must not, therefore, be assumed, in preparing for steam warfare, that the sail will be entirely supplanted by steam, or that steam fleets may dispense with crews of able seamen (Sir Howard Douglas' 'Naval Warfare with Steam')."

Again, in the third edition of the "Seamanship," published in 1866, Admiral Luce himself, while apparently not quite so sure that sails were still the main thing, says:

"It is true that steam may place his force more at the disposal of the naval commander-in-chief than formerly, yet bearings may get hot, shells may drop into the best masked engine-room, and machinery of the most perfect description may fail at the hour of need; and without meaning to maintain the infallability of sailoring, it is not very certain that coal whips will altogether outlive tacks and sheets."

The above perhaps voice only the dislike of the seaman for the "tea kettles," and probably represent no more than the average conservatism of the day, but the same cannot be said of a paper on "Naval Training," published by Admiral Luce in the Naval Institute, in March, 1890. It is impossible to select appropriate short extracts from this, for no one paragraph is more emphatic

than another in its claim for the retention of sail power. The whole paper is a cry from the heart of a born seaman fighting against the inevitable abolition of his loved masts and spars. At that late date it was necessary to grudgingly admit that there could not be enough sail put aboard a battleship to do her any good, but the plea that *"full sail power should be retained aboard all cruisers"* is pathetic in its intensity. The author proves conclusively that, because of her sail power, the old *Brooklyn* was a better ship than the *Chicago* or *Newark*.

To the school of thought so ably represented by Admiral Luce, and perhaps in no small degree to the admiral's own personal efforts, we owed the installation of the useless and since discarded masts and spars in the *Chicago* and other vessels.

Therefore, it is recommended to all who base their views on the recent paper on amalgamation by Admiral Luce, and especially to the "American Citizen" of the *North American Review*, that they consider from the records whether the admiral's attitude toward the replacing of sail by steam was such as to justify faith in his views on the next step in the same course of development, which is "amalgamation."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SMALL-ARM TRAINING IN THE NAVY.

By LIEUT. RIDLEY MCLEAN, U. S. Navy.

Now that attention is being concentrated throughout the service on developing a high degree of skill with the guns of the ship; now that routine drills have largely given way to loading drill, Morris-tube, and fire-control exercises; now that we are daily getting nearer and nearer to the day when every drill on a ship of war will be of a thoroughly practical nature, designed to perfect us in the actual duties which the navy is required to perform, it is pertinent to inquire whether we are not still unconsciously carrying out a number of obsolete drills and wasting time in training ship's crews with weapons which the navy neither would nor should ever have occasion to use? In other words, not only is it pertinent to inquire whether or not the considerable time which is necessary to render a ship proficient in small-arm work is justifiable from a point of view of naval efficiency, but also, whether for naval requirements the entire branch of small-arm training is not obsolete and unnecessary.

Small-arm work, though generally understood to embrace practice with the rifle and revolver, is here used with a much more comprehensive meaning. Manifestly, the skill developed in firing rifles and revolvers on a range cannot be fully utilized unless the men who undergo this training have been so drilled that a body of them can be brought into action in an approved military manner. Furthermore, the instructions for small-arm practice for the navy include, in addition to ordinary range-firing, practice with the 3-inch field pieces, boat guns, etc. We are thus forced to consider small-arm training as including not only all forms of firing prescribed in the instructions, but also all drills which are required to utilize them in actual service. This includes infantry,

both close and extended order, landing force, artillery, skirmish runs, armed boat drills, etc., etc. It is evident that either the drills without the firing-practice, or the firing-practice without thorough drills, will not produce the desired degree of efficiency, because these are interdependent, one upon the other.

It is therefore evident that in a consideration of this question, it is illogical to temporize with the problem; if we carry these weapons, and instruct the crews in their use in a perfunctory manner, if we devote only a small amount of time to range-firing, an occasional drill period to infantry, artillery, or landing, it will result in obtaining a body of men which through lack of skill is comparatively inefficient, and hence dangerous in the same sense that an unreliable revolver is a danger to the man that carries it. Therefore, a half-hearted attention to small-arm work is not only very inadvisable but is dangerous in that it may lead us to depend at some critical moment on a body of men who are insufficiently trained for the function they may be called upon to perform. Hence it would seem that we should take up small-arm training seriously, and render this branch as efficient as possible.

This subject is brought up for discussion at the present time because a marked diversity of opinion in the service seems to exist on this point, and it is believed that only by a careful analysis of the whole question can we arrive at a correct conclusion.

At the present time a unanimity of opinion exists that great-gun work is everything; that a ship is built to carry and fight her great guns; that without skill in gunnery the function of the ship cannot be fulfilled, and that anything which interferes with this training should be discarded; but nevertheless our ships continue to carry small arms, field pieces, and machine guns which cannot be efficiently utilized elsewhere than on shore; we devote hours to training with them, though frequently the training is only half-hearted and not of a really practical nature, and for this very reason results in the various armed detachments being inexpert in their actual duties. Manifestly this is illogical. Small arms either have a definite place on board ship and merit a loyal support, or else they are obsolete as naval weapons, out of place on board ship, and should be removed, thus permitting us to devote our undivided attention to great-gun work.

The question then resolves itself purely into a consideration of what duty the navy is required to perform.

This may be sub-divided into:

(1) Duties in peace.

(2) Duties in war.

In considering each of these conditions it is well to further sub-divide our consideration of the question under the general headings:

(1) Duties of gunboats and small cruisers.

(2) Duties of heavy vessels.

DUTIES OF THE NAVY IN PEACE.

(1) *Gunboats and small cruisers.*—As a general rule (and this paper is intended to deal only with average conditions), it may be said that during times of peace these vessels perform police duty; a number of them are kept in commission on each station for this purpose alone; their function is to visit and afford protection to American citizens and American interests at any place in which trouble threatens. Gunboats and cruisers are engaged on this duty almost constantly in the small turbulent republics in the West Indies, Central and South America, as well as in Chinese ports, and from time to time in other remote countries.

(2) *Heavy vessels.*—These are, generally speaking, engaged in drills and fleet maneuvers during peace, but in case of an uprising of importance in any foreign country, even vessels of this class are ordered to the scene of disturbance for the purpose of protecting American interests.

DUTIES OF THE NAVY IN WAR.

(1) *Gunboats and small cruisers.*—This may be considered to be confined to blockade duty, cutting out and minor operations against isolated vessels, ports, etc.

(2) *Heavy vessels.*—Duties in squadron chiefly against similar ships of the enemy, but at times in cooperation with the army ashore in repelling a siege.

WHAT DOES THE PERFORMANCE OF THE ABOVE DUTIES INVOLVE?

Gunboats and small cruisers in peace.—An uprising breaks out, and these vessels hasten to the scene. Their orders are to protect American interests. Their actual duties vary with each occa-

sion; sometimes the moral effect of their presence is alone sufficient; sometimes the ship's battery may be brought into service; but more frequently the protection consists in landing a force of men to guard the consulate or other house or compound in which American citizens seek asylum from the irresponsible insurrectionists. One thing is certain, however, namely, that when such orders are received by a vessel of this class and she sails on her mission, if she exerts any active protection other than moral suasion, it is vastly more probable that she will use her landing force and small arms than that she will use her ship's battery. In fact, so important is this feature that it would be no exaggeration to say that a gunboat or small cruiser which did not have a landing force ready to throw ashore in a moment's notice would be unfitted to perform duty of this nature. Therefore, whether a force is actually landed or not, the ordinary peace duty of gunboats and small cruisers renders a landing-force not only desirable, but entirely necessary. Hence it is clear that these vessels could not concentrate attention exclusively on their battery and be efficient for the duty which they may have to perform.

In order that the importance and amount of this duty may not be underestimated, I have compiled the following data from the reports of the Chief of the Bureau of Navigation for the past fifteen years. The data is incomplete, as the nature of the duty performed is frequently not described in the cruising-reports, and I have endeavored to include only the instances in which vessels were engaged in actively protecting our interests.

The following table does not therefore include all vessels cruising in the waters indicated, but only those specially mentioned as being engaged in the protection of American interests during unsettled conditions.

1890.—Haytian waters, 2 vessels.
Honolulu, 2 vessels.
Central America, 3 vessels.
Samoan waters, 2 vessels.
1891.—Central America, 1 vessel.
Chilian waters, 3 vessels; landed 102 men.

The following is quoted from the report of the Chief of the Bureau of Navigation:

"The constant demand for vessels to protect American interests makes it necessary that our squadrons in foreign waters be in-

creased as rapidly as the vessels now under construction become available."

1892.—Report not available.

1893.—Venezuela, 2 vessels.
Brazil, 1 vessel.
Hayti, 2 vessels.
Central America, 1 vessel.
Hawaii, 3 vessels.
Samoa, 1 vessel.
Yangtse River, 2 vessels.
Korea, 1 vessel.

1894.—Korea, 1 vessel.
Rio de Janeiro, 4 vessels.
Central America, 5 vessels.
Uruguay, 1 vessel.
Yangtse, 1 vessel.

1895.—Honolulu, 1 vessel.
Zanzibar, 1 vessel.
Syria, 1 vessel.

1896.—No report available.

1897.—Syria, 2 vessels.
China, 2 vessels.
Uruguay, 1 vessel.

1898.—Spanish-American War.

1899.—Samoa, 1 vessel; landed and engaged natives.
China, 2 vessels.
Central America, 2 vessels; landed 2 companies.
Philippines. Large number of gunboats landed repeatedly.

1900.—China. Boxer rebellion. Large number of vessels, including all nations and all classes of vessels, landed and constantly engaged for weeks.
Philippines. Continuation of operations afloat and ashore. Practically every vessel on Asiatic Station either landed men during the year or stood in constant readiness to do so.
Central America, 3 vessels.
Venezuela, 1 vessel.
Santo Domingo, 1 vessel.

The following is quoted from the report of the Chief of the Bureau of Navigation:

"At least two gunboats on the Atlantic and one on the Pacific are always necessary in connection with disturbances in the countries bordering on the Cambbean."

1901.—Philippines. Nature of service in Philippines in which all had almost daily use for small arms, continued. Many landing forces during year.

China. Troubled conditions in South, three vessels stood in readiness to land.

1902.—Philippines. Constant operations afloat and ashore.
La Guayra, 1 vessel.
Colombia, 1 vessel.
Panama, 2 vessels.

The report of the Chief of the Bureau of Navigation states that "The Department found it necessary in the spring of 1902 to prepare a group of vessels to be in readiness to meet the frequent calls made for the services of our navy in different quarters of the Caribbean and West Indies"; also, "It is necessary to have a sufficient number of small vessels attached to this (Pacific) Station, to insure frequent relief for vessels at Panama, and adjacent ports on the coast of Central America."

1903.—Santo Domingo, 2 vessels.
Venezuela, 1 vessel.
Honduras. 3 vessels; two heavy vessels.
China, 3 vessels.
Philippines. Continued operations though less active than preceding years.

The Chief of the Bureau of Navigation states:

"This (Caribbean) squadron is to provide at all times a force in Caribbean waters which can proceed quickly whenever needed to such points as may demand protection for American interests. This squadron is composed of cruisers * * * The vessels of this squadron were also engaged at various times in protecting American interests in Venezuela, Hayti, Santo Domingo, and Honduras."

1904.—Panama. Revolution; whole Pacific and Caribbean squadrons.
Santo Domingo, 1 vessel.
Chemulpo, 1 vessel.
China, 5 vessels.
Philippines, various gunboats.

1905.—Santo Domingo, 4 vessels.
Chemulpo, 2 vessels.
Panama. 2 vessels.
Syria, 1 vessel.
China, 2 vessels.
Philippines, small gunboats.

1906.—Philippines, small gunboats.
Santo Domingo, constant operations.

The above is a partial list of the actual duties which the navy has been called upon to perform in the past fifteen years, which, whether it resulted in the actual use of small-arms or not, anticipated their use, and in the majority of instances the ships would have been ineffectual for the duty without them.

The following is a partial list of the actual landing operations since the Spanish War.

1898.—Bluefields. Marietta and an English cruiser.

1899.—Samoa. Philadelphia. Gunboats in Philippines. Frequent landing parties.

1900.—Philippines. Frequent landing operations, Olongapo, Iloilo, Zamboanga, Aparri, Vigan, Kabalete, Sikogan Island.

China, Boxer trouble. Landed from various ships. The combined fleet probably landed 5000 men in all.

1901.—Philippines. Don Juan de Austria, Isla de Cuba and other gunboats landed frequently.

1902.—Philippines. A continuation of above.

The above represent actual, not theoretical conditions. The data show what has occurred, and what will probably recur. Nor, is this use of small-arms confined to our own service. Though data in regard to foreign services is incomplete, the records show that in the last few years every first rate navy has had frequent occasion to land naval forces for actual shore service. The British in the Bemi Expedition, in South Africa, and in Somaliland; Germany in the Herrero uprising in Southwest Africa, also last year in Southeast Africa; the French in Madagascar, and all nations in China in 1900, are the most noteworthy.

Heavy vessels in peace.—The use of small arms by heavy vessels is unusual in peace, still the above table shows that, in any extensive uprising, large vessels are used to protect American interests, and that on such occasions as the trouble in Panama, Central America, and China, when they are so employed, it is the small-arms rather than the heavy guns which afford the protection. The extensive landing in China in 1900, at which time every nation found it necessary to land a force from their heavy ships, and the sending of heavy ships to Honduras and to Panama, proves that if these vessels are to do their whole duty, even they cannot discard their small-arms.

Gunboats and small vessels in war.—The nature of the duties

would probably be such as to necessitate frequent use of armed boat-crews, cutting-out parties, and doubtless occasional landings, such as at Guantanamo in 1898. All of these duties require small-arms, for it must be remembered that except against small or unprotected vessels or block-houses, the battery of a gunboat is of little value in war.

Heavy vessels in war.—It is clear that, unless the duties of the navy change completely, small-arms are necessary on gunboats and cruisers both in peace and in war, and on heavy vessels in peace. It follows, therefore, that the frequent statement that small-arms are out of place on board ship can only apply to heavy vessels in war. But is it true in this case? Undoubtedly the primary duty of a heavy ship is to fight the enemy's ships, but without theorizing let us examine the records of heavy vessels in recent wars. It is well known that at Santiago the Spanish fleet landed and assisted the army both with great guns and with small arms. In South Africa the British navy made lasting fame by its operations on shore. In Port Arthur, as at Santiago, the crews fought with the army to repel a siege. It, therefore, follows that small-arms are indispensable even on heavy vessels during war, for, though these weapons *might* be unnecessary, the fact that they *have been used* in three successive modern wars would indicate their utility, and in fact their necessity, under certain conditions, even on the heaviest vessels.

It, therefore, seems fair to conclude that the opinion that attention should be devoted exclusively to great-gun training, and that small-arms have no place on board a modern man-of-war is fallacious. Undoubtedly the relative importance of the two compares as does the sun and the moon, but the rising sun in rendering the moon invisible does not annihilate it; neither can the increased skill and enthusiasm in great-gun training remove the necessity for carrying small-arms on every ship of war, and hence of training men to use them; and the fact that the use of weapons of war in actual service involves life and death, prohibits perfunctory training with them, and requires thoroughness both in training the individuals in range-firing and in drilling the various units under practical conditions so that officers may be able to handle, to the best advantage, bodies of men who have been thus trained.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

APPROXIMATE DIMENSIONS FOR A "COMPROMISELESS SHIP."[1]

By Asst. Naval Constructor Richard D. Gatewood, U. S. N.

After reading with much interest Comdr. Fiske's Prize Essay and his later article on "Compromiseless Ships," it occurred to me that it would be of interest to many officers to know in a fairly definite way how the design of the principal dimensions of such a ship would be worked into shape. No attempt will be made here to argue for or against such a ship, as such an argument if properly looked at in all its phases would require a very extended treatment. There are of course certain practical lines between which we *must* go, and whenever a point in the design would seem to go beyond these it may be necessary to mention it as a plain, bare fact, no argument will be attempted.

The purpose of this article is to show how to go about the design of the principal dimensions. What are the questions that arise concerning them? What are the limits to which we can go within reason from the engineering and constructive point of view, and what are the authorities for these limits? To be sure, this is to be a compromiseless ship, from which the layman might get the idea that there would be no limits, but the ship is to be a rational ship, not a notional one, hence the "limits."

If I did not believe that such a ship would come to be built, if I did not believe that the conception is one based not on fanciful but on practical lines, if I did not believe that it is not only a possibility but a near probability, I would most certainly not be

[1] The writer wishes to express his indebtedness and thanks to Captain William Hoogaard, Royal Danish Navy, for the great assistance that his notes and lectures have been to him, and also to thus publicly express his gratitude to Constructor J. J. Woodward, U. S. N., for the help received by the writer from a paper on this subject printed in the volume of The Transactions of the Institute of Naval Architects and Marine Engineers in 1891.

writing this for intelligent men to read. At this very moment England is laying the keel of her new *Dreadnought*—18,000 tons if you please—not far from Comdr. Fiske's limit of 20,000 tons for his "compromiseless ship." The design has been completed, worked out exactly by the master mind of Philip Watts, approved by the British Admiralty, than whom there is no more conservative body of thinking men in existence—what more is needed to bring a 20,000 ton compromiseless ship within the realm of every day happenings?

And so, assuming that such a ship has been thought necessary, what would be the qualities she must possess and how would we be able to give them to her?

To begin with, she must be a battleship—a "compromiseless battleship." Now just what are the claims of such a ship? Briefly they are just these:

1. It should be so armed and protected as to be able to cope with the guns and armor of the battleships of possible enemies on slightly more than equal terms. This means that it should possess first of all, armor-piercing guns of greatest possible power and caliber, and also a secondary battery of light guns capable of effective use against cruisers, torpedo-boats, or lightly protected parts of the enemy's battleships.

2. It should be entirely *seaworthy* in the waters in which it is to operate, which, in this case, are all the waters of the world.

3. It should have submerged torpedo tubes.

4. It should have excellent speed and maneuvering power, and at moderate speeds it should possess endurance required by the nature of its work.

These are the most prominent claims, and to meet them would require at least twelve 12-inch guns in turrets 10 inches thick with 14-inch barbettes, side armor of 11 inches at belt amidships, four submerged torpedo tubes, twenty 3-inch guns, and a speed of at least 22 knots—the above figures being obtained by a careful comparison of contemporaneous designs. By comparing still further it is seen that it is rational to assume that such requirements can be made only with a displacement of at least 20,200 tons.

From now on we go a little beyond the beaten track. The road on which we start is well laid, level, thoroughly reliable and trustworthy,—for a considerable distance, we are proceeding from definite objects to a definite object—but for the final steps we go beyond this well-laid road in order to arrive.

In the first place the design of a man-of-war cannot be made according to mathematical formulæ. Comdr. Fiske has said that he "labored for several weeks in a persistent endeavor to arrive at some law by which, for a given size of ship, the best combination of speed, armor, and armament could be determined," and that he "failed to find any such law, largely because he did not know the conditions under which the ship would have to fight." But had he known the conditions he would have been but little nearer to his law. No such law exists.

The several elements of a design may admit occasionally of scientific treatment by means of exact empirical formulæ,—for example, the buoyancy, stability, and speed,—but a formula or law does not exist for combining the above elements with strength, endurance, protection and armament and arriving at the best result. This has always been, is now, and in all probability will continue to be, a matter of opinion, or rather, difference of opinion —and so let us leave it.

We will begin then from that old standby of the naval architect known as the "weight equation." This is simply a mathematical expression for the fact that the sum of the component elements of a ship's weight must equal its total displacement. These elements we may divide into four groups, (1) hull and equipment, (2) propulsive apparatus complete, (3) armament and ammunition, and (4) protection. Our weight equation now becomes:

$$\begin{aligned}\text{Displacement} = &\text{ Wt. hull and equipment,}\\ &+ \text{ machinery and armament,}\\ &+ \text{ protection.}\end{aligned}$$

The designer's problem may be presented to him in a variety of ways but the only one that concerns us at present is how to get out a set of principal dimensions for a ship whose displacement is given as 20,000 tons and whose speed is to be 22 knots.

To discuss in detail the various terms of the above mentioned weight equation would be to discuss the question of whether or not we could fulfill the aforesaid requirements on a displacement of 20,000 tons. This, although very interesting and closely allied to our subject of principal dimensions would be almost too much to attempt under that heading, but a word or two on the subject of displacement will not be amiss as serving to show what questions arise in the mind of the architect when this question is mentioned.

In designing an ordinary ship, not a compromiseless one, we are only able upon a given displacement to improve one or two of the elements of the design at the expense of the others, and if the displacement can be increased each element will be benefited.

Apart, however, from the absolute gain to each element, due to this increase of displacement, the larger ship possesses certain inherent advantages over the smaller:

Greater seaworthiness and a better gun-platform.

Better protection of buoyancy and stability by comparatively more minute water-tight subdivision.

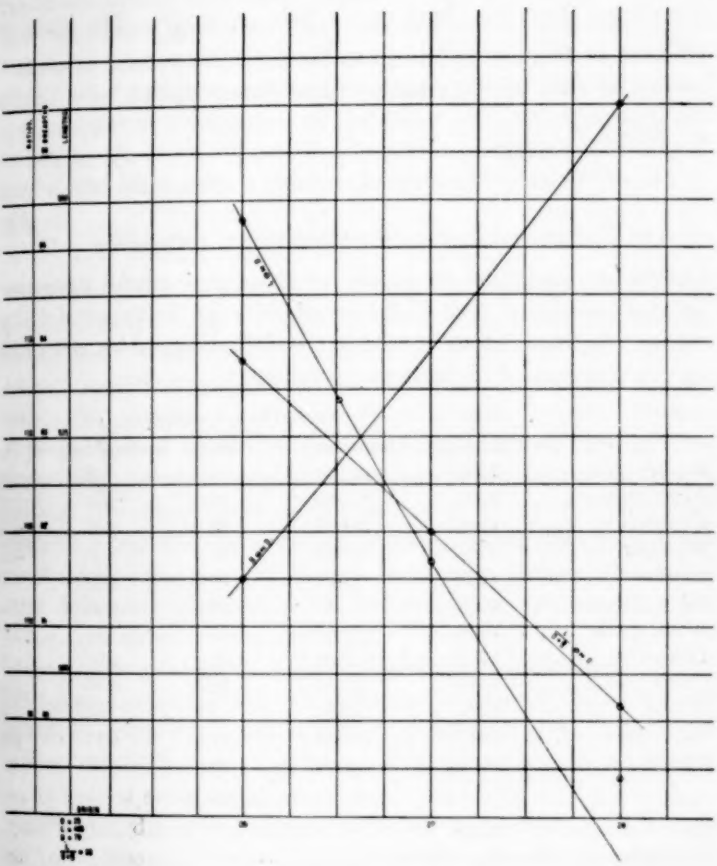
More economical propulsion, greater sea speed and greater radius of action. Concentration of armament, a distinct tactical advantage. Better protection by armor because thickness of armor need not be increased with displacement and same area will protect a greater tonnage.

That there are disadvantages connected with increase of displacement cannot be denied. The cost per unit ship is much greater, and so risk of ships being lost is increased. [But right here it is as well to mention the fact that risk of total loss is smaller for the larger vessels on account of the better subdivision.] There is less maneuvering power, particularly if the draft of water is restricted and, as Capt. Mahan argues, there is usually a loss in flexibility of movement as soon as we go above certain displacements for certain types. Also the ship presents a larger target.

The whole history of warship design is one long series of steps toward an increase in displacement, and, curiously enough, there have been no backward steps. In fact, by studying, even casually, the progress of the science of building warships we are at once struck with the fact that the improvements made in the various types have been made possible almost entirely by an increase in displacement, and there can be but little question that the maximum size is not yet reached in any type. This tendency to increase displacement would have run to even greater lengths than it has already done were it not for two very important and practical objections: (1) The extreme reluctancy to expend such very large and always increasing sums on a single unit of power, and (2) the great difficulties in providing docking and harbor accommodations for vessels, say, of over 15,000 tons.

The above are the simple facts of the case. Our displacement being settled as 20,000 tons let us proceed now to the question of determining the outside form of the hull both below and above water.

This is determined by the principal dimensions, the length,



breadth and depth, and by the form of the lines. To determine the principal dimensions of such a ship as the one in question is a matter requiring much experience, judgment, and data from which to work. Each of these dimensions is determined with respect to absolutely different things and each one must be thought out carefully by itself, never forgetting at the same time certain empirical ratios with respect to each other that have been found to exist in successful ships of similar design.

The process just here is a tentative one and the designer's judgment and experience will count for much. Connecting these principal dimensions are certain coefficients that enable us to start about laying down the lines. The water-line coefficient is the ratio between the area of the water-line and its circumscribing rectangle. Let this equal $= \gamma$ then $\gamma = \frac{A}{LB}$. The block coefficient of fineness is the ratio between the volume of displacement and that of the circumscribed parallelopiped. Let this $= a$, then $a = \frac{V}{LBD}$.

The coefficient of fineness of midship section is the ratio between area of midship section and circumscribing rectangle $= \beta = \frac{X}{BD}$. Others are used, but by means of these and careful comparison we can come to a very fair determination of the principal dimensions. As data let us consider the following tables and decide on our first set of dimensions as follows:

	Year of launch.	Normal load displacement.	Max. attained or designed speed.	$\frac{L}{B}$	$\frac{B}{D}$
Maine	1899	12,300	18.0	5.38	3.07
New Jersey	1904	14,950	19.0	5.71	3.21
Connecticut	1904	16,000	18.0	5.86	3.14
Majestic	1895	14,900	17.5	5.20	.273
London	1899	15,000	18.0	5.33	2.80
King Edward ...	1903	16,350	18.5	5.45	2.92
Wittelsbach	1900	12,000	19.0	5.77	.273
Tennessee	1903	14,500	22.0	6.89	2.91
California	1902	13,700	22.0	7.22	2.89
Drake	1901	14,100	24.1	7.04	273
Jules Ferry	1901	12,400	22.0	6.74	2.67
République	1902	14,900	18.0	5.58	...

Name.	Disp.	a Block coef.	β Midship Sect. coef.	γ Waterline coef.
Kearsarge	11,500	.646	.957	.757
Maine	12,585	.655	.950	.758
Rhode Island	15,000	.669	.968	.772
California	13,700	.561	.960	.705
Formidable	15,000	.654	...	...
Duncan	14,000	.604	...	...
Kaiser Class	11,130	.600	.857	.811
Drake	14,100	.534	.927	.681
Tennessee	14,500	.560	.958	.682
Connecticut	16,000	.661	.964	.762

First of all we know that the displacements increase as the cubes of the dimensions. Let us take for a type ship our own *Connecticut*. Her displacement is 16,000 and her principal dimensions are $L = 450$, $B = 76.8$, $D = 26.75$. The displacement of our ship being 20,200 or ¼ more, if we multiply each of her dimensions by $(\frac{5}{4})^{\frac{1}{3}}$ and keep approximately the same form of lines we will have at least approximate dimensions to start with. Performing the above operation we arrive at $L = 485$, $B = 82.7$ and $D = 28.81$. With these to begin from we now come naturally to a discussion of the effect of increase or decrease of each of the above dimensions on the nautical and military qualities of our design.

THE DRAFT.

This dimension is influenced chiefly by such practical considerations as the depth of harbors and docking accommodations. United States warships are built on an even keel so that the greatest possible displacement for minimum draft may be obtained. At present, the normal draft of our largest ships is 24′ 6″ and unless we would very materially restrict the actions of our compromiseless ship it would hardly be well to go much above 25′ 6″ normal draft, which means about 27′ 6″ maximum draft. We will then have to reduce the dimensions of 28.8 obtained above. But first let us see the considerations that arise in the determination of the other dimensions so that we may not conflict with them in this alteration.

The question of length is largely determined by the speed. The well-known mechanical relation between the two may be expressed by the equation $V = \sqrt{L}$ where $L =$ length in ft. and $V =$ speed of ship in knots. Our speed is to be 22 knots: $L = 484$ not far from our first estimate.

But in the modern high speed ships of the battleship class with full lines it has been found necessary to increase this length from 5 to 15 per cent. Just how to increase it is a matter purely of tank experiments with models. No formula will give us our answer, and judgment even is very apt to be at fault on this question. Definite figures cannot here be given, but a brief consideration of the limits governing the case may help us to come to a better approximate result.

Length helps speed, and so for a given speed, by a simple in-

crease of length for full line ships (within limits) we are able to do with less I. H. P. Length is favorable for driving up against a sea, helping to fine the lines somewhat.

Length is favorable for good steering qualities due to a certain stability in the motion of stream lines acting to steady the ship in line of motion. On the other hand by a too great increase in length we reach a point where the frictional resistance due to increased wetted surface is greater than the gain from reduced wave resistance, particularly at cruising speeds. Length means increase of hull weight, entailing more framing and greater provision for structural strength. Length means greater armor weight for same percentage of protected area of side. There are but few dry docks that will accommodate great lengths.

Length is not favorable for maneuvering, increasing the resistance to turning. And also greater length means greater target area.

These are the most important points that enter and must all be given some relative weight in the design.

The question of beam, to which we now come is not determined so much with regard to width of docks or to speed as to stability, since the position of the metacenter is determined chiefly by the beam. The metacentric radius of any ship is the distance from center of buoyancy to the metacenter, and if $BM =$ metacentric radius, we may write that $BM = K \times \frac{B^2}{D}$, where K is a constant, $B =$ beam, and $D =$ draft; so that as we increase beam the metacentric radius increases as the square of this dimension. Now the initial stability is determined by what is known as the metacentric height, which is the distance between the center of gravity and the metacenter. The position of center of buoyancy is fixed by the form of lines of hull and remains practically constant on an increase of beam. The position of the center of gravity depends entirely on the disposition of weights in the ship and has nothing directly to do with beam. But the position of the metacenter varies directly as the square of beam, as we have seen, so that if we increase beam the distance between c. g. and metacenter increases, in other words we have increased our metacentric height and initial stability, and the stiffness of the ship in a sea way. This stiffness should be ample to prevent a too great heel by turning and when side compartments are flooded,

but not so great as to impair the steadiness of the gun platform and render the motions of the ship jerky and unsteady.

In considering the influence of beam on the speed it is easy to see that an increase of beam on a given displacement is accompanied by a change in the form of the lines, influencing thus the resistance. Exact formulæ for the effect of this influence do not exist, but what model experiments there are seem to bear out the fact, for an increase of beam of say 5 per cent we must increase the effective horsepower by the same amount if we expect to get the same speed as before increasing beam, and that if length be kept const. ratio of $\frac{B}{D}$ can be varied widely without any very appreciable effect on resistance.

The above considerations are the most important that enter into the determination of the principal dimensions for such a ship. After duly considering them, comparing with tables giving data as shown, and using careful judgment, let us consider that we finally arrive at the following dimensions for our compromiseless ship: $L = 525$ feet, $B = 83$ feet, $D = 26.6$ feet, block coef. $= .610$, midship section coef. $= .95$, water-line coef. $= .73$, and these give then $\frac{L}{B} = 6.34$ and $\frac{B}{D} = 3.1$ and displacement $=$ 20,200 tons.

The length has been increased above the rough preliminary estimate in order to get the speed. The beam has been increased slightly in order to be sure of a good metacentric height and in order also to get the displacement at the expense of draft. The draft has been decreased in order not to restrict too greatly the actions of the ship. The block coefficient and all the others have been made somewhat smaller in order to allow for an increased fineness of the lines over those of our type ship the *Connecticut*, which we must do if we are to get the speed.

Even with the above dimensions and coefficients determined the designer is still at liberty to greatly vary the design in the form of the lines.

The operation of laying out the lines is quite mechanical, requiring, however, as do all the other elements at this stage of the design, great experience and judgment. This operation will not be here entered into in detail but the chief points to be considered are the following:

It is required that the center of buoyancy be directly under the center of gravity, otherwise the ship will trim by the head or stern, according as whether the former point be abaft or forward of the latter. From a practical point of view it is well to have the center of gravity about at midlength. The lines then must be so designed that the center of buoyancy may be there also. If it be found at first that the c. b. is too far forward then the lines forward must be fined to bring it aft, and vice versa.

The length of entrance and run must be decided upon. In connection with this comes the run of water to the propeller. This run must be "clean and free" and to make it so we must often make the run rather finer than entrance, thus throwing the center of buoyancy forward, producing thereby a slight change of trim by the heel which is not usually such a very undesirable thing after all as it is favorable for steering, and, if necessary, it can be remedied by a judicious disposition of the weights later on in the design. The lengths of the entrance and run are usually made about the same.

In this design, as has been said, it is found that it is desirable to design the ship on an even keel and so there will be no trim. There must also be considered the shape of stem, stern, stern-post, shaft-swellings, struts, and "the general contour of dead-wood forward and aft."

By remembering the above considerations, by comparison with lines of other ships (in this case *Connecticut, Drake,* etc.), and by the use of several rather simple formulæ the lines are now laid down.

Coming now to the question of seaworthiness we at once realize that many points are involved, such as the safety, steadiness, dryness, strength, etc. Some of these would require pages if considered in detail but here it is sufficient to remember the following points: Even under the most unfavorable conditions (except long continued synchronism) the ship must not approach its angle of vanishing stability. The movements must be small and slow. The period of oscillation for a single swing should, in a ship of this type, be about 7½ to 8 seconds. Even in rough weather the guns should be capable of free use. The ship should be strong enough to withstand the action of the heaviest sea, and also the stresses produced by firing the guns.

Now in order that the vanishing angle of stability may not be

approached we must have a good freeboard because this feature of the design governs the last part of the stability curve. The more freeboard we give the longer will be the stability curve, or better still, the farther along the curve will the point of vanishing stability come. Freeboard is also favorable to dryness, enabling us to place the guns higher, and also affording better living quarters. It has the disadvantages of increasing hull weight, raising center of gravity, and presenting larger target however, but within the above limits we may safely assume that since the main guns should be not less than 28 to 30 feet above water the freeboard of our design should not be less than 21 to 22 feet, let us say 22 feet.

The considerations influencing us in our choice of a set of preliminary dimensions having now been weighed, and a certain definite set having been tentatively decided upon, there remains one other element which we have but briefly mentioned. This is known as the "stability equation." The way in which this equation is derived is quite complicated but a statement of what it really is and an example of its form will not be out of place here. The equation simply expresses the relation that must exist between beam and draft in order that a given metacentric height may be attained. It is *not* exact but when the several constants in it are chosen with care and by means of careful comparison with the type ship, we may rely upon its results with a very fair degree of security. The form in which we are about to use it is:

$$b = \sqrt{\frac{\frac{\alpha d^3}{3}\left(\frac{1}{2} + \frac{\alpha}{\gamma} + 3v\right) + \alpha d \times MG}{.008 + .0745\,\gamma^2}}$$

Where—

b = beam
d = draft
MG = metacentric height
α = coef. of fineness
γ = water-line coefficient

and $v = \frac{GO}{d}$, where GO = distance of c. g. above water-line.

This is the original formula as worked out by M. Normand, the celebrated French naval architect and engineer. In the actual use of it we must, as previously stated, be careful of the constants in the denominator. Applied to the present case it works out in

this way. M. Normand's original formula for the metacentric radius is:

$$BM = (.008 + .0745\,\gamma^2)\,\frac{b^2}{ad}$$

Now we know the BM of our type ship, the *Connecticut*, to be 18.7 feet. Assuming that we do not know the exact value of the constant .008 let us assume that our BM is to be 19.5 and solve for the above constant as follows:

$$19.5 = (x + .0745 \times \gamma^2) \times \frac{b^2}{ad}$$

$$= (x + .0745 \times .73^2) \times \frac{83 \times 83}{.61 \times 26.7}$$

from which $x = .0064$ instead of .008 as in the original formula. With this constant and the coefficient previously decided upon we are now in a position to determine the beam corresponding to any given draft if only we know the value of the quantity γ. The determination of this at so early a stage in the design must of necessity be a very unsatisfactory and difficult proceeding since its value depends upon the position of the c. g. of the ship, which depends upon the position of the various weights, which in turn depends upon the type of the design, for example, whether the engines will be of the turbine type with low c. g. or of reciprocating type with a higher c. g., whether the ordnance be all in heavy turrets well up on upper deck, or whether some of it will be a deck height lower, etc.

But this is just the sort of thing that one is constantly encountering in ship design and again we must use judgment and care. The height of the *Connecticut's* c. g. above the water-line is 3.1 feet. Let us assume that that of our design is to be 3.2 feet. Substituting now the values of $d = 26\text{-}27\text{-}28$ we get for the corresponding values of $B = 81.5\text{-}83.9\text{-}86.5$. Now since $D = 20{,}200 = \frac{aLBD}{35}$ we obtain for the corresponding values of $L = 548\text{-}512\text{-}479$ and the ratios of length to draft plus freeboard, or $\frac{L}{d+g}$ are 11.4, 10.5, 9.58. Using convenient scales with drafts as abscissæ and B, L, and $\frac{L}{d+g}$ as ordinate plot the curves as shown. In the first of this paper it was tacitly assumed that we

could satisfy the various members of the weight equation upon a displacement of 20,200 tons if we used dimensions approximately given by a comparison with our type ship. We have just found the relations between these dimensions that will satisfy the stability equation and our problem is thus solved "on paper" with as close a degree of accuracy as can reasonably be attained.

From the curves the dimensions corresponding to the draft of 26.6 feet to which we have supposed ourselves limited are $b = 83$ feet, $L = 528$ feet and we then have $D = \frac{aLBD}{35} = 20{,}200$ tons.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE CONDITIONS OF THE CONTINENTAL NAVAL SERVICE.

By CHARLES OSCAR PAULLIN.

The nineteenth century worked its marvels on sea as well as on land. The progress of invention, the discovery of new sources of wealth and power in nature and in man, and the development of powerful states have revolutionized transportation and communication by sea, maritime pursuits, and naval science. Commerce has found fleeter wings; and it no longer waits on the caprice of Æolus. Countless steamships with enormous tonnage and high rates of speed have in large measure supplanted the small, snail-like sailing craft of our fathers. The hazards of sea-going trade have been greatly reduced. Invention has pacified Neptune's fierce temper. The breed of pirates and corsairs, has been exterminated by the long muscular arm of the modern State. The privations of ocean-travel which were distressing accompaniments of the Colonial period in America, were succeeded about the middle of the last century by the comforts of the first steamships, and these within the memory of young men have yielded to the luxuries of the floating palaces of the sea.

Complementary to these transformations in commerce, navigation, and travel by sea, have come improved methods of their defense. Modern naval science in all of its aspects has been developed. Glancing for a moment in retrospect at the long line of naval progress, one sees it pass from the ancient row-galleys, to the sailing ship of the early modern age, and from thence to the steamships of to-day. The motive power has changed from human muscle to wind, and from wind to steam. Placed beside the ironclad battleships, the light, wooden frigates of the Revolution look almost as antiquated as the Grecian galley with its

figured prow. Smart, trim, beautiful vessels were the Revolutionary craft, but how small, simple, and crude they now appear. Indeed, a new type of poet, one who loves raw force first, and the picturesque afterwards, has risen to sing the glories of new navies and new seas.

Other naval changes have been made, as significant as those in style of vessel and motive power. Ships of war now wear heavy coats-of-mail. The "great guns" and the "long guns" of the Revolution are neither great nor long beside modern cannon. A new type of sea officer has been trained to meet the new conditions of naval service. It would puzzle a modern officer to take a schooner from Boston to Plymouth, for his seamanship is now fitted to steamships. By over-study of modern armament, torpedo-boats, and the latest naval maneuvers, his "weather eye" has lost something of its skill for reading in the skies the coming of storms or sunshine. Trim and immaculate in their uniforms, the American naval officers of to-day, who have entered the naval profession by the way of their technical studies at Annapolis, little resemble their hardy prototypes in the Continental navy, to whom clung the barnacles of their apprenticeship aboard merchantmen.

Notwithstanding this revolution in naval science, a consideration of the conditions of the Continental naval service and of the naval policy of the Marine Committee has to-day a practical value for naval experts. Certain fundamental principles in naval science do not change. Captain Mahan in his "Influence of Sea Power upon History" has pointed out that, while naval tactics vary with the improvements in the motive power and armament of fleets, the basic principles of naval strategy do not. They are as enduring as the order of nature. For example, one cannot conceive that there will come a time when an inversion will be made of the strategic principle, that an enemy should be struck at his weak point. Captain Mahan even finds it worth while for the benefit of his fellow-experts to set forth with some detail the naval situation in the Carthaginian wars.

When America in these first years of the twentieth century makes an invoice of her resources, she counts first her great prairies of the Mississippi Basin, her rich mines of the Alleghanies and Rockies, and her wealth of manufactories and their products. In 1775 her assets were of a different sort. America then was

a mere strip of seacoast cut into a series of peninsulas by the lower courses of a number of navigable rivers. Her interests and her wealth were much more largely maritime, than now. Attention has already been directed to the wide pursuit of commerce, ship-building, fishing, and whaling in New England. It remains to be said that in the middle and southern colonies commerce and ship-building were important industries. During the Revolution, Virginia put more naval ships afloat than any other colony. In the Colonial period communication between the towns of the colonies was best by water. The inhabitants of America during this period were amphibious. They have lost this quality, for their character is now set by the "West" and not by the Atlantic seaboard. In 1775 America had, relatively, many more seamen than in 1898.

In the light of these facts it seems somewhat singular that the Revolutionary navy was forced to spend most of its days in port vainly trying to enlist seamen for its depleted crews. To be sure the lack of sufficient armament, naval stores, and provisions was felt, but it was the lack of sailors that constituted the chief obstacle to the success of the Continental navy. Those vessels that finally weighed anchor were wanting, as a rule, in this prime naval requisite. The same causes that prevented seamen from enlisting lowered the quality of those that did enlist, and kept them from entering for longer than a single cruise. A ship's complement of sailors was often ill-assorted. Seamen were improvised from landsmen; captured British seamen were coaxed into service; and for one cause or another many nationalities at times shipped side by side. These conditions made for insubordination, and even mutiny. On one occasion seventy or eighty British sailors, who were enlisted on board the Continental frigate *Alliance*, bound for France, planned to mutiny and carry the frigate into an English port. In order to obtain seamen many measures were resorted to by Congress, the States, the Marine Committee, Navy Boards, and commanders of vessels. Premiums were given to foreigners for importing seamen;[1] wages were advanced to recruits;[2] attempts were made to place embargoes upon privateers;[3] bounties were paid to seamen enlisting for a

[1] Journals of Continental Congress, April 17, 1776.
[2] Ibid., March 29, 1777.
[3] Rhode Island Colonial Records, VIII, 53.

year;[4] inducements were offered to those captured from the enemy to get them to enter the American service;[5] some seamen were impressed; glowing advertisements were inserted in the public prints;[6] and broadsides, which cleverly recited the many advantages of the Continental service, were displayed in sundry taverns.[7]

All these efforts were defeated by the seductive allurements of privateering. The Revolutionary Congress was poor and paid poor wages. After its seamen had enlisted, they were toled away by mercenary privateersmen. These same privateersmen were accused of taking the naval stores and the artisans of Congress in order to fit out their own ships. The owners and commanders of privateers, as they received the whole of their captures, could afford to treat their crews liberally. It was generally asserted that they paid higher wages than did Congress or the States. Privateering was more popular, more elastic, and more irregular than the other naval services. When no one was looking, parts of cargoes could more readily be appropriated for private use without waiting the tedious process of the admiralty courts. Privateers could devote all their time and energy to commerce-

[4] Journals of Continental Congress, July 11, 1780.

[5] Ibid., August 5, 1776.

[6] In July, 1778, when a joint American and French attack on Newport was planned, the Navy Board at Boston inserted a notice in the Providence Gazette, requiring sailors who were enlisted to repair to their vessels, and calling for recruits. This call was in the following language: "All seamen now in America, who regard the Liberty of Mankind, or the Honor of the United States of America, as well as their own Advantage, are now earnestly entreated to enter immediately on board some of the Continental Vessels, in order to afford all possible Aid and Assistance to His Most Christian Majesty's Fleet, under the Command of the Count de Estaing, the Vice-Admiral of France, now in the American Seas, for the Purpose of assisting these American States in vanquishing a haughty and cruel Enemy, too long triumphant on these Seas. Now is the Time to secure to yourselves Safety in your future Voyages, and to avoid the cruelties which all those experience who have the Misfortune to be captured by the Britons; and now is the time to make your Fortunes."—Providence Gazette, July 25, 1778. See also advertisement in Connecticut Gazette, March 7, 1777.

[7] A facsimile of a most interesting and rare broadside will be found in C. K. Bolton's Private Soldier under Washington, page 46. This broadside was designed to attract recruits to the ship *Ranger*, Captain John Paul Jones, fitting out in the summer of 1777 at Portsmouth, New Hampshire, to sail for France.

destroying, unfettered by the miscellaneous duties which often fell to naval ships.

The backbone of the privateering interest was in New England. Silas Deane said in 1785 that four out of every five of the privateers of the Revolution came from the States north and east of the Delaware River. This probably overstates the proportion in favor of the northern States.[9] Pennsylvania and Maryland did considerable business, but farther to the southward the industry was less flourishing. The Virginia privateers did little. Massachusetts sent out one-third of all the privateers. From 1777 until 1783, inclusive, the Massachusetts Council issued 998 commissions. In 1779, 184 prizes captured by privateers were libelled in the three admiralty courts of this State. The average burden of these captured vessels was one hundred tons. Rhode Island's best year was probably in 1776 when thirty-eight vessels were libelled at Providence. A list of 202 privateers has been made out for Connecticut. In 1779 twenty-nine vessels taken from the British by privateers were libelled in the Pennsylvania Court of Admiralty. During the last six years of the war Maryland issued about 250 commissions. Boston was the chief center for fitting out privateers and for selling their prizes, although towns like Salem and Marblehead did a thriving business.

Not a few of the failures and misfortunes of the Continental navy are to be laid at the doors of the Yankee privateersmen, whose love for Mammon exceeded that for their country.[10] A more patriotic course was to have been expected of certain substantial merchants who embarked in the business of commerce-destroying. But on the other hand one might easily be too severe on many bold, simple, seafaring folk. The war, which deprived them of their gainful pursuits at sea, as a recompense, now pointed the way to a new and attractive calling. Wives and babies were still to be fed, and plans for sweethearts to be realized. The new

[9] Collections of New York Historical Society, Deane Papers, V, 466.

[10] There is much evidence on this point. See especially, Publications of Rhode Island Historical Society, VIII, 256; William Vernon, Commissioner of Navy Board at Boston, to John Adams, December 17, 1778; Force, American Archives, 5th, II, 1105; John Paul Jones to Robert Morris, October 17, 1776; Ibid., 599, Mrs. John Adams to John Adams, September 29, 1776; Ibid., 337 and 622; Ibid., 5th, III, 1513, Benjamin Rush to R. H. Lee, December 21, 1776; and C. K. Bolton, Private Soldier under Washington, 45, 46.

trade was as alluring as a lottery. Had not a neighbor drawn a competence sufficient for almost a lifetime by a successful haul of the enemy's rich West Indiamen? It is true that another neighbor, who but recently sailed proudly for sea with womenfolk, waving a last good-bye, now languished in a prison-ship off New York, or was starving in the old Mill Prison at Plymouth, England. "But then a man must take his chances," each privateersman argued, "and it may be I, who by a fortunate cruise shall bring home enough Jamaica rum to fairly float my schooner, and every pint of it is as good as gold coin."

Due credit must always be given to the hardy and venturesome privateersmen for supplying the army and navy with the sinews of war, which they captured. To be sure, if Congress or the States wished their captured property, it was to be had by paying a good round price for it in the open market. Even here the governmental agents sometimes suspected collusions between buyers and agents of the captors to run up prices to the disadvantage of the government.[10] The privateersmen were engaged not in patriotic, but business ventures. Could one-half of this irregular service have been enlisted in the Continental and State navies, the other half could not have been better employed than in its work of distressing the enemy's commerce, transports, and small letters of marque. Zealous eulogists of the privateers have over-run the cup of their merit. They have not always pointed out that the number of American privateersmen, merchantmen, fishermen, and whalemen captured by British privateers and small naval craft was comparable to the number of similar British vessels taken by the American privateers. The prison ships and naval prisons of the enemy at New York, in Canada, the British West Indies, and England were at times crowded with Americans

[10] In the case of Continental prizes the Navy Board at Boston discovered collusions which were detrimental to the government. Ordered to buy the Continental prize *Thorn*, it writes to the Marine Committee that the agents and captains interested in the prize refuse to let it have the *Thorn* at a price to be fixed by three disinterested appraisers, and that, "taking our chance, in the purchase by auction, amongst such circles of men in combinations is a miserable one." In the same letter the Board also writes concerning the *Thorn* that "bets run high that she will sell for two hundred thousand pounds."—Records and Papers of Continental Congress, Department of State, 37, pp. 145 and 147.

captured at sea.[11] A few of these men she enlisted in her navy; with others she manned a whaling-fleet for the coast of Brazil composed of seventeen vessels. It is worthy of note that the supplies captured from the British were often almost indispensable to the Colonists; while similar captures made by the British had to them little value.

Another factor in the naval situation of the Americans was the existence of State navies in Massachusetts, Rhode Island, Connecticut, Pennsylvania, Maryland, Virginia, North Carolina, and South Carolina. The fleet of Massachusetts comprising sixteen armed vessels was the most active and effective of the State fleets. The Virginia navy numbering about fifty vessels was poorly equipped and rendered little service. These fleets were made up of all sorts of naval craft; sailing vessels variously rigged, fire-ships, floating batteries, barges, row-galleys with and without sails, half-galleys, and boats of all sizes. Most of this craft was designed for the defense of coasts, rivers, and towns. This was especially true of the galleys, which were shallow vessels, some seventy or eighty feet in length, carrying two or three cannon, sometimes as large as 36's or 42's. Only some sixty of these vessels of the State navies were well adapted for deep-sea navigation.

To a limited extent both privateers and State vessels were placed at the service of the Marine Committee. There were cruises, expeditions, and defenses of towns in which two, or the three services participated. In such cases the senior Continental captain was the ranking officer, or the commodore of the fleet, as it was then expressed. To the extent that State vessels and privateers might be concerted with the Continental vessels, it would seem at first blush, that they undoubtedly were elements of naval strength to the Marine Committee. This was by no means true. These concerted expeditions proved disappointing, and when too late the committee became wary of them. Proper subordination, upon which naval success so much depends, could not be obtained in these mixed fleets. The commander of a State vessel or the master of a privateer, for aught either could see, subtended as large an angle in maritime affairs, as an officer of Congress, which body was to them nebulous, uncertain, and irresolute.

[11] See Gomer Williams, Liverpool Privateers, Chapter IV, Privateers of the American War of Independence. From August, 1778, to April, 1779, Liverpool fitted out one hundred and twenty privateers.

If the location and physical form of colonial America with reference to the sea, tended to develop a maritime people, they also made most difficult the problems of naval defense. As has been pointed out, the territory of the revolting colonies comprised a narrow band of seacoast divided into a number of peninsulas. All the large towns were seaports. Had the peninsulas been islands, their defense against the great sea-power of England would have been an impossibility. The connections by land on the west side of the thirteen colonies gave Washington a most valuable line of communications from Canada to Florida. Had the revolting territory lain compactly, approaching a square in shape, with a narrow frontage on the sea, its naval defense would have been a simple problem.

Having decided late in 1775 to make a naval defense, Congress early in 1776 took into consideration the establishing of one or more bases for naval operations.[12] There were needed one or more strongly fortified ports where the Continental fleet and its prizes would be comparatively secure from attack, and where the armed vessels could equip, man, and refit. The ports best adapted for naval stations were Boston, New York, Philadelphia, some point on or near the James River in Virginia, and Charleston, South Carolina. Lesser towns had their advocates and their hopes. In February, 1776, Gurdon Saltonstall, of Connecticut, wrote to Silas Deane, that New London would be "the Asylum of Cont. Navey," for "one they must have of necessity."[13] The southern ports were not available for several reasons, but chiefly on account of their distance from the center of maritime interests in New England. New York was occupied by the British. Philadelphia had many points in its favor, not the least of which was the location there of Congress and the Marine Committee. Its occupation for a time by the enemy in 1777 and 1778 and the close watch, which his armed vessels maintained at the mouth of Delaware Bay, greatly impaired its usefulness as a harbor of refuge for the Continental vessels. Boston was by far the most available port. After its abandonment by the British in March, 1776, and the shifting of the theater of the war first to the Middle, and later to the Southern States, it was left comparatively free from British interference. It was the naval emporium of the Revolu-

[12] Journals of Continental Congress, March 23, 1776.

[13] Papers of Silas Deane in the Library of the Connecticut Historical Society.

tion, where naval stores, armament and equipment for vessels of war, seamen, and ships could be procured, if they were to be had at all.

The British had naval bases in America that left little to be desired. When they seized New York in September, 1776, they obtained not only a military point of the highest strategic value, but also a secure naval station for fitting out, and refitting their privateers and naval ships. From New York, centrally situated with reference to the revolting colonies, her vessels proceeded along the Atlantic coast both northward and southward on the lookout for American merchantmen, privateers, and naval craft. Their favorite patrolling grounds were off the entrances of Delaware, Chesapeake, and Narragansett Bays. British vessels were often to be found off Boston Bay, Ocracoke Inlet and Cape Fear in North Carolina, Charleston, and Savannah. The British occupation of Newport from 1776 to 1779, and of Savannah from 1778, and Charleston from 1780, to the end of the war, afforded other convenient stations for British operations against the shipping of the colonies. St. Augustine was a port of much importance in the movements of the enemy's smaller ships. The naval stations at Halifax, Jamaica, and Bermuda, while not so convenient as those enumerated, were sources of naval strength to the British. Halifax was a base for the naval operations against New England. It scarcely needs to be said that the ports mentioned were in a way secondary bases of operations, and that England's center for ships, seamen, and supplies of all sorts was the British Isles.

From this account of the respective naval stations in America of the two combatants one proceeds naturally to a comparison of their fleets. The rude naval craft of the Americans, two-thirds of which were made-over merchantmen, was outclassed by the vessels of the Royal navy at every point. All told, there were during the Revolution fifty-six armed vessels in the Continental navy, mounting on the average about twenty guns. The vessels in the British navy when the Revolution opened in 1775 numbered 270, and when it closed, 468.[14] Of this latter number, 174 were ships of the line, each mounting between sixty and one hundred guns. The naval force of the Americans when it was at its maximum in the fall of 1776 consisted of 27 ships,

[14] Clowes, Royal Navy, III. 328.

mounting on the average twenty guns.[15] At the same time the British had on the American station, besides a number of small craft, 71 ships, which mounted on the average twenty-eight guns.[16] Of these, two were 64's; one, a 60; seven, 50's; and three, 44's. The British vessels, being so much larger than the American, were naturally armed with much heavier guns. Very few 18-pounders were to be found in the Continental navy. The frigates were usually mounted with 12's, 9's, and 6's; and many of the smaller craft with 6's and 4's. The guns on the larger British ships mounted 18's, 24's, 32's, and 42's.

An exhibition of figures showing the difference in size between one of the largest of the frigates built by the Marine Committee in 1776 and a typical 100-gun ship of the line of the Royal navy is interesting not only by way of comparison, but also as giving a notion of the size of Revolutionary naval craft. The figures in feet for the American 32-gun frigate, *Hancock,* and for the British 100-gun ship, *Victory,* respectively, were as follows: Length of gun deck, 137 and 186; length of keel, 116 and 151; width of beam, 34 and 52; depth, 12 and 22. The tonnage of the *Hancock's* companion frigate, the *Boston,* was 515 tons; of the *Alfred,* the first ship fitted out by Congress, 200 tons.[17] Continental naval craft such as the *Cabot, Wasp,* and *Fly,* were smaller still than the *Alfred.*

The number of seamen and marines in the Continental navy is believed not to have exceeded at any time, three thousand men. The exact number of commissioned officers in the Continental navy and marine corps may not as yet have been ascertained. Owing to the diffusion of the power of appointment, the Naval Department of the Revolution seems to have prepared no perfect list of its officers. The best list of commissioned officers, and one that in all probability needs few corrections was compiled in 1794 in the Auditor's Office, Department of the Treasury.[18] This gives the names of 1 commander-in-chief, 45 captains, and

[15] Few of these vessels were ready for sea for lack of crews. The British also suffered greatly during the Revolution owing to the scarcity of seamen. This the First Lord of the Admiralty attributed to the loss of 18,000 American sailors, who had contributed to the manning of the British fleets in former wars.—Annual Register, 1778, 201.

[16] Boston Gazette, November 4, 1776.

[17] A battleship now building at the New York navy yard has a displacement of 17,000 tons.

[18] Manuscript list in Division of Manuscripts, Library of Congress.

132 lieutenants, or 178 commissioned officers in all, in the navy proper; and 1 major, 31 captains, and 91 lieutenants, or 123 commissioned officers, in the marine corps. With the exception of the years 1776 and 1777, when the total number of officers in actual service was about one-half of the above figures, the number of officers at sea or attached to vessels in ports was much less than one-half. In 1902 the American navy consisted of 899 commissioned officers of the line, arranged in eight grades.

In 1775 the British navy contained 18,000 seamen and marines, and when the war closed in 1783 this number had risen to 110,000. The total "extra" and "ordinary" expenses of the Royal navy from 1775 to 1783, as voted by Parliament, amounted to £8,386, 000."

Both Continental and State naval services suffered from the lack of *espirit de corps,* naval traditions, and a proper subordination and concert of action between officers and crews. Bravery is often a poor substitute for organization and naval experience and skill. Navies can be grown, but not created. The quality of the Continental naval officers, diluted it is true by the presence of a few "political skippers," was upon the whole as high as the circumstances of their choice, and the naval experience of the country admitted. Many of them were drawn from the merchant service, and a few had some months' experience in State navies. Six captains appointed by Washington entered the service of the Marine Committee.

The vessels of the Continental navy were procured and managed under several Continental auspices. The Marine Committee, with its predecessors and its successors in naval administration was of course the center of naval activities, the naval administrative organ of the Revolutionary government. Washington fitted out one fleet in New England and another in New York; and Arnold fought with still another fleet, one of the most important naval engagements of the Revolution. The American representatives in France, who were responsible to the Foreign Office of Congress, and the Continental agent at New Orleans, who worked chiefly under the Committee of Commerce, fitted out fleets, and were vested with important naval duties. At one and the same time three Committees of Congress, the Marine Committee, Committee of Foreign Affairs, and Committee of Commerce, were fitting out armed vessels.

[11] Clowes, Royal Navy, III, 327.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WITH THE BALTIC FLEET AT TSUSHIMA.

By LIEUTENANT R. D. WHITE, U. S. Navy.

INTRODUCTORY NOTE.—The following account is compiled from information obtained from one who was present at the battle. Having no station in battle he was selected to observe and record the events of the battle. This duty he performed with admirable care and accuracy. The times of the execution of certain maneuvers and the character of these maneuvers are indisputable. The range he recorded in each case was either measured by Barr and Stroud or was the range used by the twelve-inch guns at the time. The courses steered were recorded with care.

The value of his observations lies in the fact that he, being a close student of modern naval science, looked not for the spectacular in battle but for matters of technical interest,—matters which bear on principles which govern in construction, maintenance, and tactics. I regret that I am unable to disclose his name. Let it suffice to say that his intelligence, his willingness to speak on the subject with honesty and without prejudice, his keen appreciation of the military strength and weaknesses of ships built and building, his power of observation in general and in detail, and his mastery of the principles of modern naval construction and warfare won my admiration and respect.

The statements made herein are in no case products of my imagination, but are his statements modified in construction and arrangement. I have merely attempted to bring out each fact, condition, and event that affected the final result and is of interest.

The morning of May 27, 1905, dawned raw and cheerless on the Baltic Fleet as it steered northeast for Tsushima Straits. A cold wind blew from the southwest penetrating to the very bones the Russian sailors, who, fresh from a tropical summer, huddled around the fire-room hatches or sought shelter in some favoring lee about the deck. A grayish mist hung chilly overhead and shut out clear vision well short of the horizon. When the rain fell later in the day it was cold and penetrant. Surely this was no day to inspire hope in the hopeless.

And a hopeless band it was. From the day of leaving Libau

there had been nothing to augur good—nothing but toil, discomfort, and anxiety. No one had known what moment the fleet would be attacked. They felt sure that the Japanese were warned of every move on their part, while of the whereabouts of the enemy they could learn nothing. Rumors had placed it here, there, and everywhere; but reliable information could not be had. Just lately it seemed to have disappeared from the face of the earth, but they knew too well that it was sure to reappear. The question was when, how? There was never a night after leaving Madagascar that did not bring the thought "to-night we shall be attacked by torpedo boats"; never a night that did not leave trace of its wearing vigilance on thought and spirit. And after all what was the use of vigilance. As a result of their vigilance at the Dogger Bank they had been held up to the ridicule of the world. It was not a band to hope for victory. What they wanted was Vladivostock, safety, and rest.

Day was just breaking when the Russian leaders sighted one of the Japanese auxiliary cruisers looming vaguely through the fog. She remained in sight only a few seconds, then slipped silently out into the mist and all that remained to remind of her was a nervous clicking of the wireless instruments in a code that the Russians could not read. It was the message going straight to Admiral Togo telling that his days of waiting were at an end. In the Russian fleet was a ship especially fitted with a wireless set capable of sending messages six hundred miles. Why she did not break up this message and all future ones is a mystery, and the fact that she did not do so must ever stand as a monument to the inability of the Russian commander to accept modern conditions. Without interference, the Japanese scouts informed their commander, not only of the enemy's position, but its course, speed, and formation.

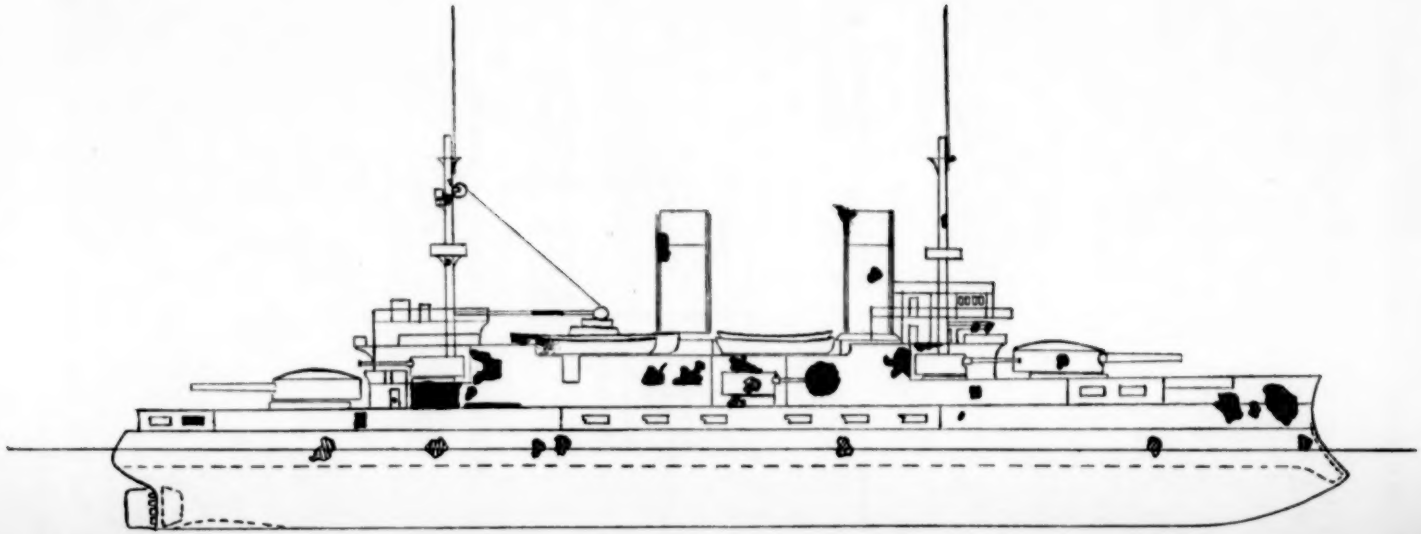
The next ship for the Russians to sight was the *Idzumo*, which for two hours kept station abreast the Russian battleships on the starboard side. When she was somewhat within 8000 yards Admiral Rodjestvenski ordered the after turret guns of all ships trained on her. Somewhat later a Japanese light cruiser squadron showed up on the port side; then a squadron of old battleships captured from China years before. This time all forward turrets were trained on the enemy, but as in the former case, the gunners were disappointed; the order to open fire never came. When

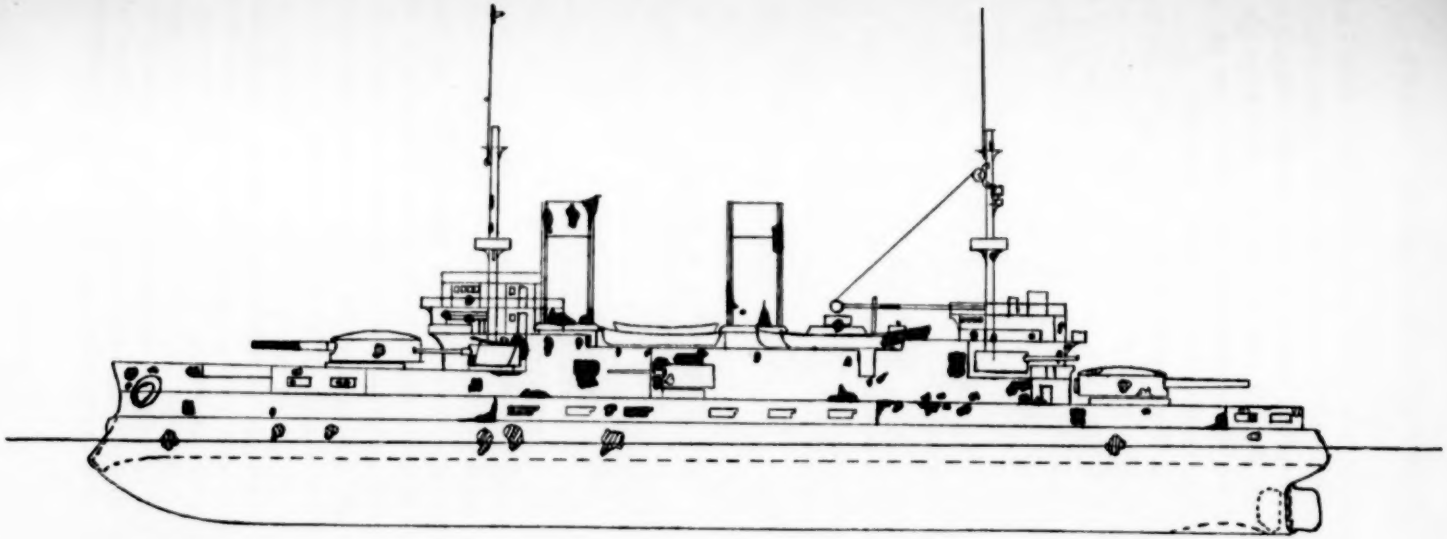
one of the old battleships came within 6400 yards a shot was fired from the *Orel*. Whether the shot was caused by a mechanical accident, whether it was due to nervousness of some pointer, or whether the temptation was too strong to be resisted, is not known, but the natural result followed. Several other ships, thinking the Admiral had ordered it, opened fire. Admiral Rodjestvenski had not ordered it, however, and he soon signalled, "cease firing," and further directed the fleet not to "expend ammunition to no purpose."

When sighted by the Japanese scouts, the Russian fleet was in two columns. The first division (the four new battleships), followed by some cruisers and auxiliaries, formed the right column.

Cruising formation forenoon of May 27th.

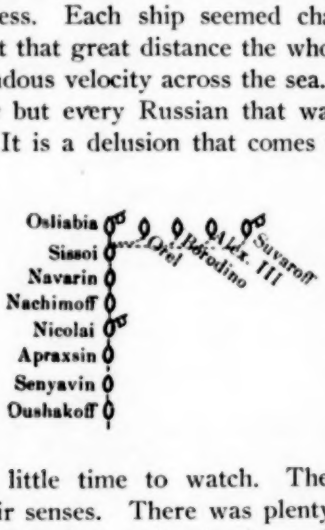
The second, Folkersham's, followed by the third, Nebogatoff's squadron, formed the left. Admiral Rodjestvenski's flag flew from the *Kniaz Suvaroff*. Admiral Folkersham's from the *Osliabia*, though that officer had died two days before. Admiral Nebogatoff's flag was on the *Nicolai* and Admiral Enquist's on the *Oleg*. Scouts kept watch ahead and to either side and the whole armada steamed at about ten knots. During the forenoon one maneuver was executed. The speed of the first division was increased to eleven knots and with this superior speed the first division was placed at the head of the left column. It may be remarked that it took practically an hour to complete this evolution. The fleet now took up *nine knots and this was the standard speed throughout the battle.*





At noon the first division executed "column right" and when the last ship had made the turn executed "column left,"[1] regaining the formation they were in before; then, increasing the speed to eleven knots, the last ship of this division was brought abreast the leader of the left column and again nine knots was assumed. It was in this formation that the enemy was met.

At 1.25 p. m. the combined squadron of the Japanese was sighted a little on the starboard bow, twelve ships in line ahead, standing almost directly across the Russian course. It was not difficult to recognize them, for every detail of their shapes and rigs had been studied from pictures for months. The *Mikasa*, flying the flag of Admiral Togo, led. Admiral Kamimura's flag flew from the *Idzuma*. A third flag flew from the *Nisshin*, whose, the Russians did not know. Their formation was faultless in its exactness. Each ship seemed chained to the next ahead; and even at that great distance the whole mass seemed to sweep with tremendous velocity across the sea. Their speed was only *sixteen knots* but every Russian that watched would have called it twenty. It is a delusion that comes to all after a long trip at sea.



But there was little time to watch. The call to quarters brought all to their senses. There was plenty to do and surely that flying line of gray lent an inspiration to haste. If Admiral Rodjestvenski desired the "L" formation in the first place he wished for it now with all his heart. He had to get his ships into

[1] Officers on the staff of Admiral Rodjestvenski claimed after the battle that the signal made for the second step of this maneuver was "ships left," which would have made the formation an "L" in shape, but inasmuch as the three ships executed "column left" without hesitation, and since the fleet subsequently steamed in the new formation for an hour without any attempt being made to correct the error, it can hardly be believed that the formation taken was the result of a mistaken signal.

column. That flying column would soon be on his flank. Something must be done and done quickly. The brilliant hour-long maneuver of the forenoon suggested itself to his mind. He would do it again. He ordered eleven knots for the first division and inclined the leader's course three points to port.[2]

This was at 1.38 p. m. The middle of the Japanese fleet was directly ahead of the *Suvaroff* and the distance, measured by Barr and Stroud, was 12,000 yards. As the Japanese column cleared the path of the Russians the course was changed to the southward till it became nearly directly opposite to the original course of the Russians, then judging his time with beautiful exactness, Admiral Togo, at 1.55, countermarched and brought his entire fleet into action, opened fire on coming to 6000 yards. As each ship made the turn she opened fire on the *Osliabia,* which at that time was stopped and was an easy target, if a ship six thousand yards away may ever be called such.

The Russian initial maneuver proved disastrous. At the end of twelve minutes the *Suvaroff* changed course three points to starboard and resumed nine knots speed thinking the left column would follow in astern of the first division. As she changed course the *Suvaroff* opened fire and signalled, "fire on the leader of the Japanese column." The *Osliabia* also changed two points to starboard hoping to fall in astern of the *Orel,* but she was too far ahead and had to stop to avert collision, thus throwing all ships astern of her into confusion. Unlucky *Osliabia!* Only three shots were fired from her forward turret. A shell struck the embrasure beneath one gun and, exploding, jammed the gun in extreme elevation and lifted the top of the turret. It will be remembered that the *Osliabia's* armor belt extends no farther forward than the forward turret; consequently when two high explosive shells struck on her water-line near the bow, they found soft spots. Each made a hole of tremendous size and the inrush

[2] As to discrepancies that appear in recorded times it must be explained that at noon the time on Admiral Rodjestvenski's flagship was set ahead thirty minutes without signal to the rest of the fleet. The remainder of the fleet retained the old time, which was about twelve minutes slow on Japanese time. Certain events are recorded as occurring at the moment it was observed that they had occurred, and the times were sometimes simply estimated. The times quoted here are those of the Russian fleet exclusive of the *Suvaroff.*

of water brought her rapidly down by the head. Three more shot holes in the forward part let in more water and when water began to enter through the gun ports of her three-inch battery the port shutters were found bent and twisted and could not be closed. A twelve-inch shell struck an armor plate on her water-line amidships, loosening the bolts. A second shell striking the same plate caused it to fall off. A third shell striking where the plate had been, opened a tremendous hole in her side and her doom was sealed. She left the line with her forecastle completely submerged, the water filling her holds with a roar, but as she turned she fired a parting shot from her after turret, a token of undying spirit; a fling of defiance to the detested "monkeys." For a while she lay on her side, her funnels just clear of the water; then slowly capsizing, she sank at 2.52 p. m. A torpedo boat went to the rescue but was unable to save more than a small part of her crew.

As the Japanese battleships passed ahead of the *Osliabia* she was left to the care of the armored cruiser squadron and their fire was concentrated on the leader of the column, the *Suvaroff*. At 2.05 the *Suvaroff* began to suffer terribly from the fire and changed course four points to starboard, hoping the Japanese could lose the range, then 5000 yards. Seven minutes later she reverted to her old course. The effect of this maneuver was disconcerting principally to her own gunners. The old maxim, "It is more dangerous to run away than to charge" seems proven. On August 10, the year before, when the *Retvisan* charged the Japanese line she was hardly hit at all. All the shots went over her. This day as the *Suvaroff* ran she received her worst hurt. The effect of this concentrated fire on the *Suvaroff* is indescribable. There was literally a rain of shells upon her. The lieutenant commanding the forward turret was struck in the neck by a flying fragment which almost severed his head from his trunk. As he was carried below another shell struck him, practically cutting his body in two. Early in the action a shell entered the embrasure in the forward turret exploding and igniting several bags of powder. The roof was blown completely off and landed on deck leaning against the turret. The conning-tower was hit repeatedly. Admiral Rodjestvenski was wounded in the head by a fragment and rendered unconscious. All the plating above the armor belt forward was shot away nearly as far aft as the turret, causing her to

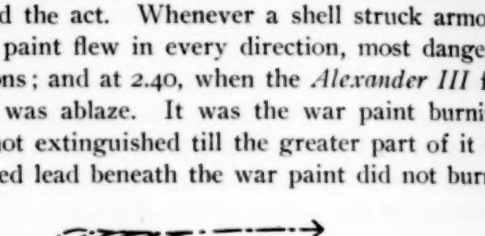
resemble a monitor. A fire burning on her quarter-deck caused the plating to settle, cutting off access to the compartment just below the upper armor deck which was used for an operating room. At 2.25 she left the line, ablaze fore and aft, unable to withstand longer the terrific bombardment. Even then she was not entirely secure, she was doomed to receive further punishment later.

The *Alexander III* led the column after the *Suvaroff* fell out and she in turn received the fire of the entire Japanese fleet, which by this time had drawn ahead until the tactical advantage was tremendous (see position of fleets at 2.30). The whole fleet could concentrate on the leader of the Russian column with a range varying only from 5100 to 5600 yards while the rear ships of the Russian column were completely out of range. In addition to this the brown powder used in the big guns of the *Navarin, Nachimoff,* and *Nicolai* enveloped themselves and the ships astern of them in smoke and restricted their fire. To drive on in the face of these odds meant certain destruction for the *Alexander III.* At 2.30 she turned east, the ships astern following in their turn. While this maneuver relieved her for the moment, each of the next few ships as it turned the knuckle received the full effect of the Japanese fire.

The fog at this time seemed to thicken and this with the smoke from the burning Russian ships practically hid them from the view of the Japanese. When a ship could be made out the Japanese fired on it, but there was no concentration of fire at this time.

The number of fires that broke out on board the Russian ships about this time is remarkable, considering the fact that woodwork was limited in accordance with modern theory, especially in the construction of the four new battleships. Thirty-four different fires broke out on the *Orel* during the day. There were three different fires in the hammocks stowed just forward of the bridge, the smoke in each case driving all occupants from the conning-tower. Hawsers caught fire easily and were difficult to extinguish. The smoke from one burning abaft the forward bridge once more drove all hands from the conning-tower. Being confined by the boats on the skids the smoke was drawn into the forward fire-room by the blowers and this compartment had to be abandoned. It filled the port forward six-inch turret with

smoke which penetrated to the lower decks; and there the crew, believing that an explosion had taken place in the turret and that the fire was spreading to the magazine, abandoned their stations and were just beginning to flood the magazine when the turret officer, attracted below by the failure in ammunition supply, saw and arrested the act. Whenever a shell struck armor plate bits of burning paint flew in every direction, most dangerous to exposed persons; and at 2.40, when the *Alexander III* fell out, her whole side was ablaze. It was the war paint burning and the blaze was not extinguished till the greater part of it was burned off. The red lead beneath the war paint did not burn, however,



and she came out of the fire as red as if she had been freshly leaded.

The *Borodino* now led the column, continuing to the eastward. The gray color of the Japanese fleet was so well in keeping with the grayish fog that they were scarcely discernible from the Russian position. Their whereabouts were followed principally by the flashes of the guns as they fired. They had drawn well ahead. Even the last ship of the Japanese column was ahead of the Russian leader, and in the fog the way of escape to the rear of the Japanese column was most inviting. At 2.50 the *Borodino* put her helm to starboard and ran to the northward, the ships

astern following in turn. If the Russians had counted on escaping unobserved they had failed to consider the glaring yellow color of their smoke pipes, which stood out like beacons in the fog. The Japanese had seen the movement as soon as it commenced and two minutes later the six ships of their main squadron swung in unison left about and advanced in pursuit. The armored cruiser squadron, passing inside, duplicated the maneuver and followed the main squadron.

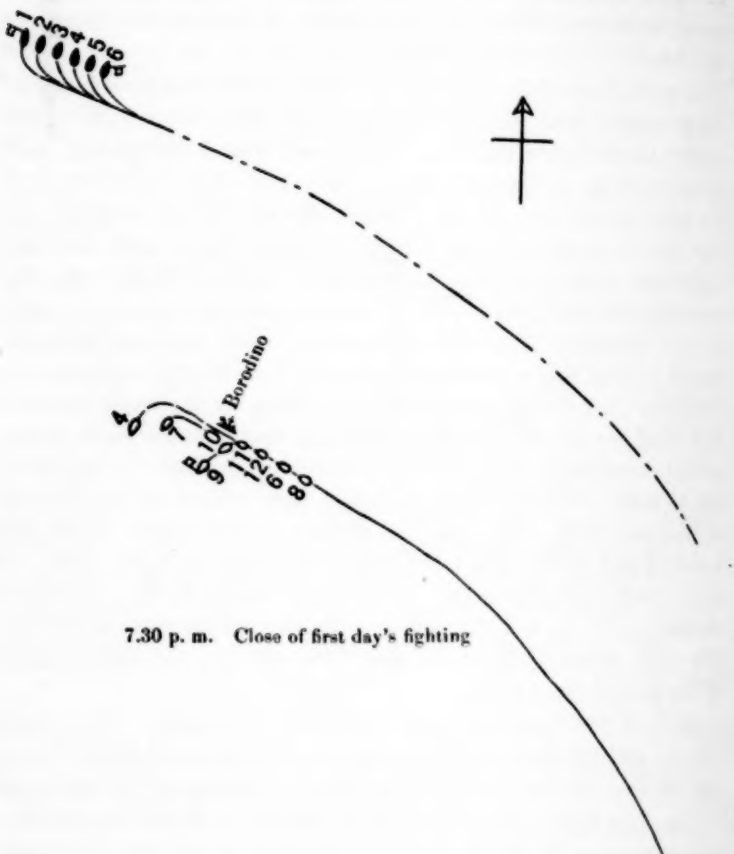
At 2.58 the captain of the *Borodino,* seeing the possibility of being caught with the whole Japanese fleet athwart his bow, turned to the eastward once more, and the fleets passed each other steaming in opposite directions. The *Orel* was selected as the principal target. In six minutes she was struck twelve times with twelve-inch shells and thirty or forty times with six- and eight-inch shells. To realize the terrific effect of this shelling one must consider that a shell filled with shimose powder is really a small torpedo; that each twelve-inch shell striking an unarmored portion and exploding made a hole seven feet high and six feet wide; that the fragments of these shells were minute particles that filled the air like driving mist; and that a dense black smoke settled down after each explosion blinding and suffocating all in the vicinity. The decks of the *Orel* were surely no playground at that juncture. One sailor is known to have been struck one hundred and thirty times by fragments from a single shell. A single shell, entering a gun port on the *Sissoi Veliki,* set fire to the paint and she left the line at 3.20, one whole side of her battery deck ablaze. After extinguishing the fire she fell in again at the end of the column.

At 3.19 the Japanese main squadron executed "ships right about," and the cruisers after passing did the same thing, bringing the fleet into its original formation, steaming to the eastward.

The *Alexander III* resumed her position as leader of the Russian column while the fleets were steaming in opposite directions, and as the Japanese advanced to the eastward she gradually eased off to the southward till 3.40, when she again headed east.

At 3.30 the *Suvaroff,* which had been steaming to the eastward at about seven knots, broke through the Russian column apparently unmanageable, passing astern of the *Apraxsin.* She was easily recognized by the ships near by, but appearing thus toward the Japanese line, and with only one mast and one funnel standing,

she was mistaken by the Russian ships near the head of the column for one of the *Matsushima* class, and was fired on by them. At 3.40 she was attacked by the Hirose flotilla but these boats were easily driven off by the Russian ships near by. Then, as the Japanese fleet swung by, she was subjected once more to their



7.30 p. m. Close of first day's fighting

concentrated fire. Thus battered by friend and foe she staggered back across the Russian line an utter wreck, only to be fired at once more by Russian guns. It is safe to say that not more than one of her guns could work effectually when Suzuki's flotilla found her at 4.45. In this practically defenseless state this flo-

tilla, and another under Fujimoto, succeeded in striking her four times with torpedoes and she sank; but not until 7.10 p. m.,—a record that speaks well for her design and builders.

Taking advantage of the thick weather the Russians turned south at 4.15, then west at 4.35, and shortly after five, headed once more for Vladivostock, having completely shaken off the enemy by the maneuver. The Japanese, seeing the Russians turn south at 4.15, swung to the south on a long radius and advanced in pursuit, but soon lost the enemy in the haze. After running thus for eight miles and finding only special service ships and some light cruisers, they turned to the northward once more in search of larger game.

During the absence of the opposing force some changes had taken place in the Russian formation. The *Alexander III* had fallen out of line but had got back again, falling in astern of the *Senyavin*, and the *Admiral Nachimoff* had dropped to last place in the line. Some time after five o'clock they were overtaken by a destroyer flying Admiral Rodjestvenski's flag and a signal for Admiral Nebogatoff to take command—the first signal that had been sent by the Admiral since the fight began.

The course was once more to the northeast with a front apparently clear and hopes of escape ran high, when at six o'clock, the main division of the Japanese fleet appeared on the starboard quarter and opened a well-directed fire on the *Alexander III*. The world may well admire this firing. In spite of the six thousand yards of range the precision was wonderful. Nothing could have withstood this bombardment long. The *Alexander III*, heeling well to starboard, soon left the line, turned on her side, then capsized and sank, going down at shortly after seven o'clock. The *Borodino*, which led the column, was next to be singled out. At 7.15 there was a terrific explosion in her magazine. She turned over right in her place in line and sank in a few minutes. The *Orel, sheering out to clear the Borodino*, became the target next. It only lasted eight minutes, but in that time the *Orel* received fifteen twelve-inch shells, practically two per minute. A fire had broken out in the Admiral's quarters on her, the blaze making a splendid bull's-eye for the Japanese gunners, something clearly defined being much needed in the fast fading light.

The *Nicolai* now turned sharply to the west, followed by the rest of the fleet in general disorder. Seeing this the main Jap-

anese division, which had drawn well ahead of the Russians, executed "ships left" to make way for the torpedo boats that swarmed in from the north, east, and west—perhaps a hundred of them, "rushing back and forth," as a Russian said, "like so many dogs."

The description of the fight between the light cruiser squadrons has been generally omitted as it at no time affected the tactics or result of the main battle. This much may be said, however: At the beginning of the fight three Japanese squadrons were sent to the southward to attack in the rear. The attack was made and the Russian cruisers and special service boats were scattered. About five o'clock the heavier Russian ships were able to assist the cruisers and inflict some damage on the light Japanese cruisers, principally on the *Kasagi*. Then for some time, after six o'clock, as the Russian fleet fled northward, Kamimura's squadron fired on the Russian light cruisers, but none were sunk.

Much has been written of the attacks of the torpedo boats during the night which followed the battle. The principal success of these attacks lies in the fact that the crews of the Russian ships, already exhausted from the day's work, were kept on the alert till well into the night. Torpedoes were often fired but generally the flash as the torpedo left the tube disclosed the presence of the attacking boat; and the *Nicolai* always headed up directly for the flash, a manoeuvre of questionable value. She was not hit at all. Nor was the *Orel*, although one torpedo was seen to pass close to her bow. The *Sissoi Veliki*, having during the day been struck by many shells in the forward part, was badly down by the head and could only make four knots. To her good fortune she was struck by a torpedo aft. The consequent admission of water submerged her screws, after which she was able to make twelve knots. She was sunk next day by her own crew by opening the sea valves, the crew having taken to the boats. The one trophy due these attacking boats is the *Navarin*. Surrounded by probably twenty boats she succumbed to four torpedoes after several hours' resistance.

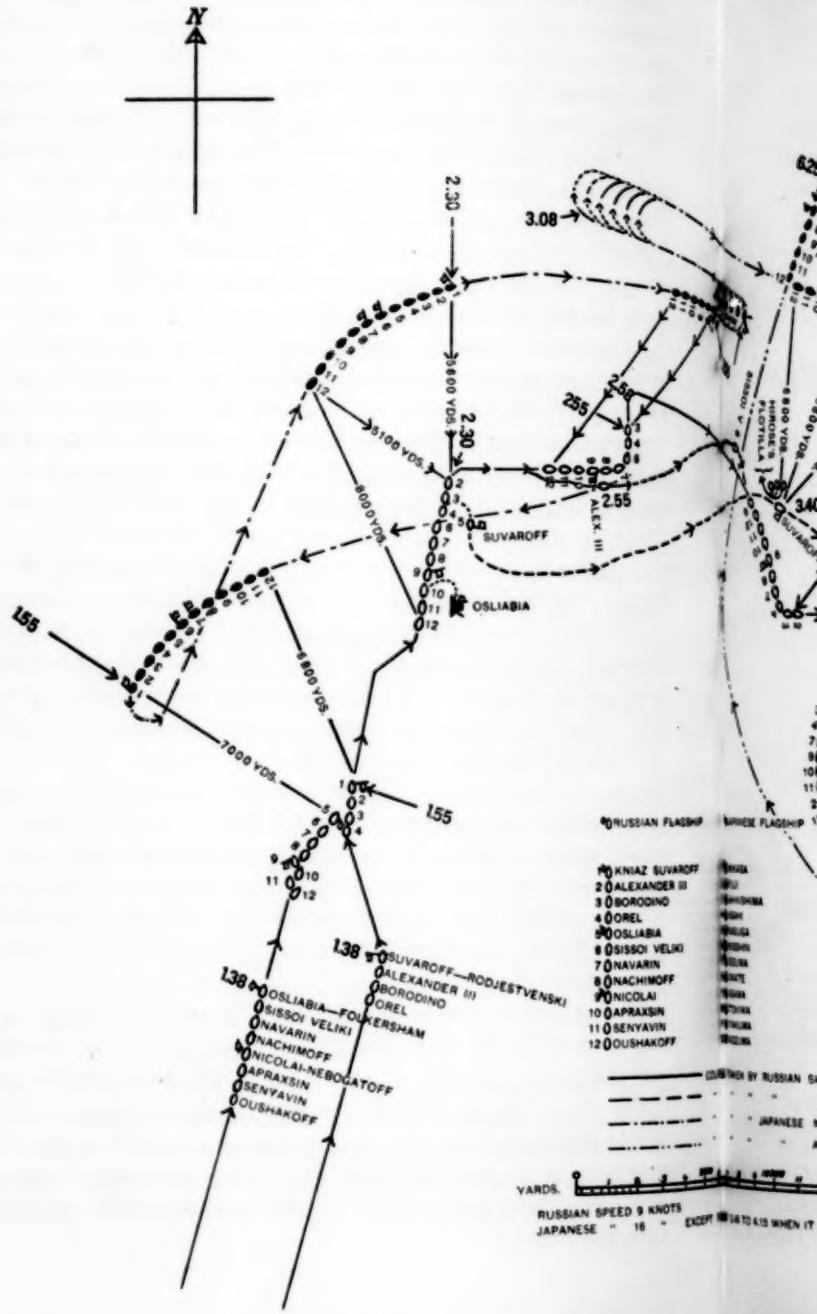
Good as was the nerve on the Japanese battleships, it seemed even better on the torpedo boats. In one instance a searchlight beam disclosed the captain of a Japanese boat with his chin in his hand, his elbow on the bridge rail, his whole attention apparently absorbed in a large cigar which he was smoking. His boat was

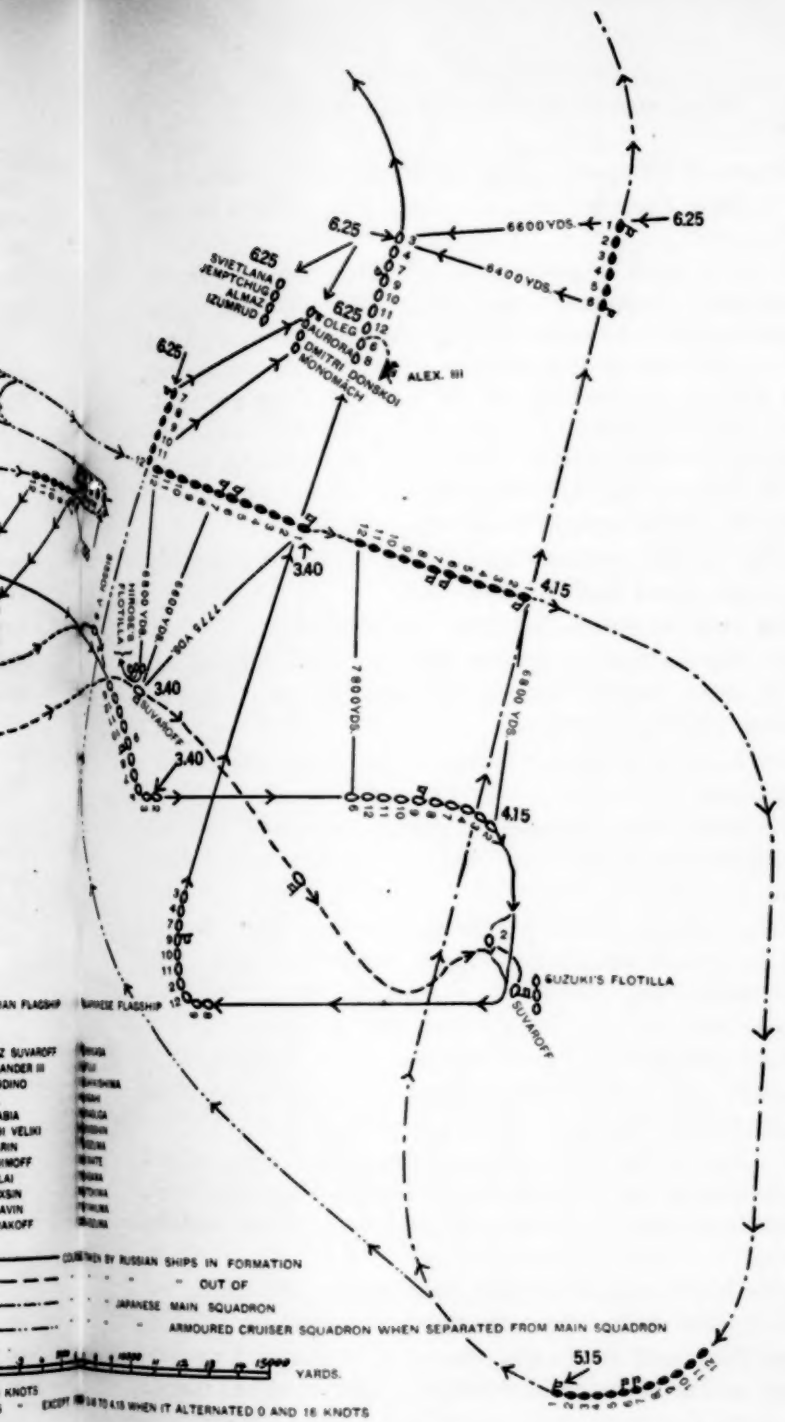
quickly sunk. Generally *each boat stopped dead in the water to launch its torpedo,* then steamed away firing with all its guns at the bridge and other exposed parts of the ship attacked. As for the Russian boats, they only served to add anxiety to the already harried crews of the Russian ships, for it was most difficult to distinguish between friend and foe. The *Sissoi Veliki* sighting a questionable destroyer during the night made the private signal. The signal was craftily returned by the boat which was Japanese. Thus deceived as to its identity she allowed it to approach within 200 yards. The result has already been described.

At the end of the first day, when Admiral Togo withdrew his main squadron from the engagement, he directed his whole fleet to assemble on the following morning at Ul-leung Island, well to the north of the scene of the first day's fighting. This was done and a second cordon was formed through which the Russians would have to break to reach Vladivostock. So it was that Admiral Nebogatoff with the remnant of the great fleet found himself completely surrounded by the enemy at 10.30 a. m. second day. He was steaming northeast, the *Nicolai* leading, followed by the *Orel,* the *Apraxsin,* the *Senyavin,* and the *Izumrud.* The day was bright and clear—ideal for good gunnery. At 10.30 the Japanese opened fire on the *Nicolai* with the *Kasuga,* which was lying on the *Nicolai's* port bow somewhat over 10,000 *yards distant.* The first shot went over, the second fell short, and the *third* struck the *Nicolai's* smokepipe. Several hits followed. There was no resisting. Four battered, belabored ships lay opposed to twelve fresh, practically uninjured ones; and one of that twelve was now hitting at a range which only one gun in the Russian ships could reach, and that gun was badly handicapped in its service. Russian crews were exhausted. Ammunition was very scarce. What was there left to do? Nebogatoff surrendered—who can say unwisely?

Thus ended the organized fighting. It was now simply a question of clearing the battlefield, pot-hunting as it were, for already crippled game. A short history of each ship best tells the story.

The *Kniaz Suvaroff,* flagship of Admiral Rodjestvenski, completely disabled by gunfire and sunk as a result of gunfire and torpedoes at 7.15 p. m., first day. Her complement numbered over 900. Only the Admiral and his personal staff are known to have been saved.


N
2.30
3.08
2.58
2.55
2.20
5100 YDS.
8000 YDS.
6800 YDS.
7000 YDS.
SUVAROFF
OSLIABIA
1.55
1.38
SUVAROFF—RODJESTVENSKI
ALEXANDER III
BORODINO
OREL
OSLIABIA—FOLKERSHAM
SISSOI VELIKI
NAVARIN
NACHIMOFF
NICOLAI-NEBOGATOFF
APRAXSIN
SENYAVIN
OUSHAKOFF
RUSSIAN FLAGSHIP
KNIAZ SUVAROFF
ALEXANDER III
BORODINO
OREL
OSLIABIA
SISSOI VELIKI
NAVARIN
NACHIMOFF
NICOLAI
APRAXSIN
SENYAVIN
OUSHAKOFF
YARDS.
RUSSIAN SPEED 9 KNOTS


6.25
6600 YDS.
6400 YDS.
SVIETLANA
JEMPTCHUG
ALMAZ
IZUMRUD
OLEG
AURORA
DMITRI DONSKOI
MONONACH
ALEX. III
3.40
4.15
7800 YDS.
6800 YDS.
7775 YDS.
6800 YDS.
HIROSE'S FLOTILLA
SUVAROFF
GUZUKI'S FLOTILLA
5.15
JAPANESE FLAGSHIP
RUSSIAN FLAGSHIP
COURSES STEERED BY RUSSIAN SHIPS IN FORMATION
OUT OF
JAPANESE MAIN SQUADRON
ARMOURED CRUISER SQUADRON WHEN SEPARATED FROM MAIN SQUADRON
YARDS.
KNOTS
EXCEPT 4.15 TO 4.15 WHEN IT ALTERNATED 0 AND 16 KNOTS

The *Alexander III* disabled and sunk by gunfire. Sunk at 6.55 p. m., first day. Complement about 900. Only three known to have been saved.

The *Borodino,* sunk by gunfire and an internal explosion at 7.20 p. m., first day. Complement about 900. Only one man known to have been saved. After the ship had capsized this man groped his way to a gunport, escaped through it, reached the surface and clung to a piece of wreckage till he was picked up and made prisoner. After the *Borodino* capsized she floated for some time bottom upward. About fifteen of her crew climbed on her bottom and waved wildly as the ships that had been astern of her passed, but it is believed that none of them were saved.

The *Orel,* terribly battered by gunfire. Surrendered to the combined fleet second day.

Osliabia, sunk by gunfire, at 2.52 p. m., first day,

Sissoi Veliki, damaged by gunfire first day. Struck by torpedo during the night, sunk by opening sea valves on second day, the crew having taken to the boats.

Nazarin, damaged by gunfire during the first day. Sunk by torpedoes at night.

Admiral Nachimoff, damaged by gunfire first day. Further damaged by torpedoes at night. Floated till 10.00 a. m. second day, when she sank.

Imperator Nicolai I damaged by gunfire first day. Further damaged by gunfire second day. Surrendered to combined Japanese fleet second day.

Senyavin, damaged by gunfire. Surrendered second day.

Apraxsin, damaged by gunfire. Surrendered second day.

Oushakoff, sunk by gunfire, principally from the *Iwate* and the *Yakuma* late in the afternoon of the second day.

Dmitri Donskoi, damaged by gunfire first day. Pursued and fired on second day by Admiral Uriu's squadron and the *Otawa,* the *Niitaka* and three destroyers. Did not sink till the morning of May 29.

Vladimir Monomach, damaged by gunfire first day and by torpedoes during the night. Sunk at 10.00 a. m. second day.

Aurora, Oleg, and *Jemptchug,* damaged by gunfire from Japanese light and armored cruisers first day. Escaped and reached Manila, where they were interned until the close of the war.

Svietlana, sunk by gunfire, principally from the *Otawa* and the *Niitaka,* in the forenoon of the second day.

Izumrud, escaped but ran aground and was wrecked near Vladivostock. The accident was probably due to derangement of her compass by gunfire.

Almaz, escaped to Vladivostock.

THE LESSON.

Gunnery and tactics must ever be the determining factors in naval battles between equal forces. This case is not an exception. The superiority in each was enormously with the Japanese.

For their gunnery the Japanese deserve unstinted praise, particularly when one considers how bad it proved to be in the action on August 10, 1904. Since then no effort had been spared to bring it to a state of perfection. Many battle practices were held and the gunners did their regular tours of instruction in school on shore in spite of the service required. Target practice was held just two days before the battle. Apparently every device known to further the science was used and with success. During the first day's action the *Orel* was struck forty-two times by twelve-inch shells and over a hundred by six- and eight-inch shells. The *Suvaroff* must have been struck over a hundred times by twelve-inch shells alone. Allowing a little over thirty-five each for the *Alexander III,* the *Borodino,* and the *Osliabia,* since all were sunk outright by gunfire, and each was subjected to the fire of the main division of the Japanese for some time, the total twelve-inch hits amount to 250. The Japanese had 16 twelve-inch guns and one ten-inch gun whose hits may have been mistaken for twelve-inch hits; in all, 17. It is hardly possible that these guns averaged more than 75 shots each, for the ammunition supply could not well have been more than 80 rounds per twelve-inch gun, and there seemed to be plenty of ammunition on board next day. Therefore, 1275 shots may be considered the maximum fired. Granting that there were 250 hits it would mean that the twelve-inch guns of the Japanese made 19.6 per cent of hits. They probably made more. Considering the range which must have been near 5000 yards, and the hazy condition of the atmosphere, this record is enough to make all who think, think hard.

The Japanese, to be sure, had little to contend with in the way of interference. The *Mikasa* was only hit about four times, and a British captain is said to have sat unharmed throughout the battle, on her quarterdeck in an armchair. And it will be remembered that Admiral Rodjestvenski's only signal was to direct all fire at the *Mikasa*. Other ships were hit less. A well-directed fire from the Russian ships would have interfered with communications, might have destroyed points of control, and surely would have shaken to a certain extent the nerve of the gunners.

With the Russians the gunnery was generally undeveloped. This important feature seemed never to have received serious consideration. Two practices were had while the fleet was at Madagascar, but the range was short, the ammunition allowance meager, and the results unsatisfactory. A cruiser was sent out from the fleet once for the purpose of testing range-finders. Of two on a certain ship, one measured 8000 yards while the other gave 12,000. No attempt was made to reduce the errors in these important instruments. When you consider that at 5000 yards the range must be known to within 150 to insure hitting, the utter unpreparedness of the Russians is apparent. If the Japanese were spared the demoralization of receiving heavy fire the Russians were terribly visited with it. Fragments of Japanese shells striking short lodged in the bores of many guns causing them to burst on firing. A shell being rammed on one of these fragments stuck in the powder chamber, afterwards broke off and thus disabled the gun. A shell striking the edge of the *Orel's* conning-tower cut all tubes leading direct to the battery. Excitement was flagrant. One Russian officer was known to whistle "full speed" to the battery, and "commence firing" to the engine room. The coal dust in crevices about the deck was stirred up by explosion and discharge and interfered with vision. Shells falling short of a ship deluged her with water, rendering her telescopes temporarily useless. Everything of misfortune that could well happen did happen, and served to make bad gunnery worse.

But good gunnery alone cannot win a battle. Admiral Sir John Fisher has said, "The man behind the gun is a great factor, but however good he may be, his services will be worthless unless he has an admiral who can put him in the right place at the right time." The Japanese tactics were admirable and their maneuvers like clockwork in exactness. The first countermarch was so

gauged as to bring the fleet into the most desirable position abreast the enemy. The tactical advantage at 2.30 is apparent even to the layman. The "ships right about" to cut off the Russian break to the rear at 2.50 must have been started within two minutes after the leading Russian ship had turned. This excellent maneuvering was of course made possible by the poor Russian gunnery. Only one Japanese ship was forced to leave the line, and in no case was the speed of any Japanese ship impaired. All maneuvers were made in obedience to flag signals, which probably could not have been successfully made in the face of a well-directed fire. The ship to receive the fire was invariably designated by flag signals, in fact they seemed to be signalling all the time.

As to the Russian tactics, there were none. Admiral Rodjestvenski was wounded early in the battle and rendered unconscious, but even had he remained in possession of his faculties there is little reason to believe that he would have proved a genius. *He had his first practice maneuvers with his whole squadron the day before the battle.* He had no councils of war, and if he had any plan of action it was not known even to his division commanders. Only one officer on his staff had received a military education. There were only two signals made by him during the battle and these have been quoted.

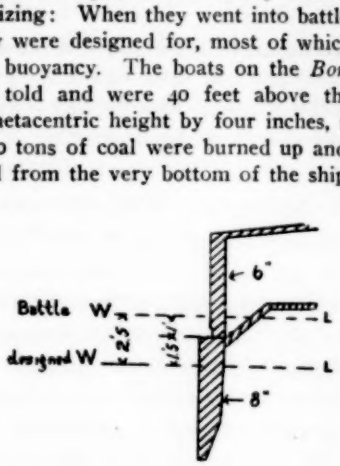
What Admiral Nebogatoff would have done may only be conjectured. He was never in Admiral Rodjestvenski's confidence, and was only on board the flagship once, then for fifteen minutes at Kamrahn Bay. As the *Suvaroff* remained in sight flying her flag till nearly five o'clock of the first day, Nebogatoff could not have, even had he so desired, assumed control of the situation. After the command had been turned over to him there was no more capping the head of his column, but the credit is due to the captains of his leading ships rather than to him. His one signal was, "Make the best of your way to Vladivostock. Course north 23° east." The question may well be asked, was there a fit man for the command in the Russian navy? Every Russian will answer, "Ah, if Makaroff had been there!" but they will name no living man.

It is easy to criticise, but only the brave may initiate. To Americans this battle is well worth studying; and all who run should read, "In time of peace prepare for war."

NOTES.

The following information is of technical interest:

The *Kniaz Suvaroff* sank right side up. The *Alexander III*, the *Borodino*, and the *Osliabia* all capsized before they sank. This much may be said as to their capsizing: When they went into battle they displaced 1800 tons more than they were designed for, most of which excess weight was above the center of buoyancy. The boats on the *Borodino* class weighed about 100 tons all told and were 40 feet above the water-line. These alone reduced the metacentric height by four inches, roughly. During the day of the battle 200 tons of coal were burned up and 180 tons of ammunition shot away, all from the very bottom of the ship. The seas entering



through shot holes above the water-line together with water from the fire hose, which was kept flowing over the decks, and which ran through shot holes in the deck and collected on the battery deck, probably reduced the metacentric height to a minus quantity.

This water from the fire hose had surprising heeling effect. When the *Orel* ceased firing at the end of the day she was heeling 10 degrees, when the water that had run through shot holes in the deck and collected on the battery deck had been pumped out, she recovered to six degrees.

Many shells landed on deck due to the angle of fall. Many landed on the roofs of turrets and many turret officers and pointers were wounded about the face and head by fragments of exploded shells.

HIGH ARMOR NECESSARY.

The *Orel* had continuous armor around her forecastle to a height of twelve feet above her water-line, yet great difficulty was encountered keeping water from coming through these holes in such quantities as to endanger her stability during the night after the first day's fighting.

Holes in the armor were easy to stop against water even if the armor was very thin, for each hole was little larger than the shell that penetrated, and such holes always had smooth faces, but when high explosive shells struck five-eighths-inch plating the holes were very large and were fringed by bent and twisted metal. It was very difficult to stop the latter class with planking. The tumble home sides of these ships made it more difficult to fit planks over the holes.

Very little armor sufficed to keep the shells out at the range used in

this battle. Around the stern of the *Orel* is a casemate of armor three inches thick. It was not Krupp or Harveyized, simply cast or moulded. It was struck by a six-inch and an eight-inch shell, neither of which penetrated.

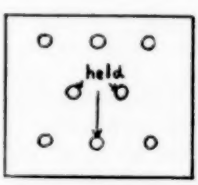
EFFECT OF SHELL-FIRE.

One shell striking a boat davit, and another striking an armor plate caused the metal to fuse and run. The metal cooled in the form of stalactites.

An explosive shell striking a six-inch armor plate on the side of the *Orel* near the bottom caused the plate to turn on its center of gravity, forcing its lower edge in and its upper edge out.

An explosive shell striking the edge of an armor plate on a turret had the same effect.

A plate on a six-inch turret of the *Orel* was struck by a single shell. The plate had been fastened in the customary manner by eight bolts. All



but three of these bolts sheared off and the three that held were badly strained. Doubtless this plate would have fallen off if it had been struck again.

A big shell struck an armor plate over a six-inch casemate gun on the *Oriiabia*. The plate was bent back on the gun, jamming it in its carriage.

Two shells hit the *Orel's* conning-tower. The former, striking near the edge, caused the plate to turn in slightly, evidently weakening the support of the adjacent plate, for when a shell struck it it was forced in till its outer edge was nearly clear of the inner edge of the former plate.

The foremast of the *Orel* was struck four separate times and remained standing.

A shell ricochetted and struck the edge of the roof of the conning-

tower, exploding as it struck. A flange of iron which surrounds the aperture was bent inward and cut all the voice tubes leading from the

conning-tower but one. The remaining one fortunately led to the central station.

One heavy gun, on the *Apraxsin*, I think, was struck fairly by a six-inch shell. It made a dent that was noticeable in the bore. The gun was loaded and fired in spite of the dent. The shell seemed to iron out the dent and the fire was continued from that gun till the end of the day.

SIGHTS AND GUNNERY.

All the telescopic sights used by the Russians in this battle were bought from Germany in the fall of 1904. They were of the prism variety. The

cross-wires were at an angle of 45 degrees to the horizontal. On each side of the cross were graduations and a table was supplied to each pointer telling him how much in divisions to allow for drift at each range. The aperture at the eye-piece was about one-eighth of an inch in diameter, and great difficulty was experienced by the pointers in keeping the target in view; particularly when the glasses got dim as they did very shortly after the firing commenced. Many reverted to the old bar sights. The mounts were flimsy. Coal had been stowed everywhere, and the shock of firing and the explosion of shells stirred up the coal dust from corners and crevices, making it impossible for anybody to see either with or without the telescopes. The paint on the inside of the barrel of one telescope burned till the glass was spoiled for vision. Shells falling short deluged the ship in salt water and interfered with vision through the telescopes. Very few telescopes were hit by fragments.

The range was first measured by Barr and Stroud. Then trial shots were fired from a twelve-inch gun till the range was established. The range necessary for the twelve-inch gun was signalled to the whole battery.

The Japanese, in some cases at least, fired their broadside guns in volleys. The *Kasuga* fired thus on the *Ural*. A volley fell once just astern of the *Orel* raising a perfect wall of water.

MISCELLANEOUS.

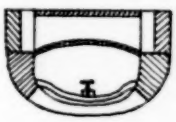
There were two explosions in six-inch turrets on the *Orel* and one in the forward twelve-inch turret of the *Suvaroff*.

The *Orel* had sixteen deck officers. Four were killed and nine were wounded in the first day's fight, leaving only three ready for duty the second day of the battle.

The after turret of the *Orel* fired 113 shells; only four were left in the after handling room when she surrendered. There were plenty forward but there was no way of transporting them to the after turret. The left gun in the forward turret was broken off and the lift for the right gun was smashed. Shells could be raised to the turret in the left lift and swung across to the right gun, but with difficulty.

The after turret had been struck on the edge of the embrasure just over one gun. The plate was bent down till the gun could only be elevated through a small arc, to 800 yards with the ship level.

The Japanese did not use their three-inch guns at all, apparently. It is thought that their magazines were used for larger caliber ammunition.



There was only one case of steering gear being disabled on the Russian ships. This was on the *Suvaroff*, and it is thought that if the ship's officers had been in the conning-tower instead of the staff, this defect could have been remedied, as the staff were in no wise familiar with the gear.

When the new guns were placed on some of the Russian ships engaged in this battle, the embrasures were not enlarged to accommodate the new guns, which consequently could not be used up to their full range.

The *Suvaroff* was provided with pipes from water-tight compartments on one side to corresponding compartments on the other. The valves in these pipes were opened before going into action. When she got three holes below her water-line on the port side these pipes allowed the water to accumulate in equal quantity on the starboard side, and she shortly regained an even keel.

In the Russian light cruisers barricades were made of hammocks between open deck guns and much was said in praise of them as proof against fragments. The boats on one cruiser had the torpedo nets triced up under them, which all agreed was excellent preventive against flying splinters.

Many Russian sailors, when their ships sunk, put on life preservers around their hips instead of placing them higher up, and turned heads

down when they got in the water and were thus drowned. A great many corpses were seen the day after the battle floating with their feet bobbing up. Some pictures were taken of them by the Japanese but Admiral Togo had the practice stopped and the plates confiscated and destroyed.

An officer from one of the fast Russian cruisers said that during the night several torpedoes were fired at his ship at so short a distance that he could hear the coughing sound as the torpedo left the tube, yet she was not hit. The cruiser was running at twenty knots. Battleship officers put their faith in twelve-inch shrapnel with fuses set at one-half second to one second, and claim that it beats the small gun for torpedo defense.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE MODERN GENERAL MESS.

By PAYMASTER GEORGE P. DYER, U. S. Navy.

It is with some hesitation that I respond to suggestions favoring the expression of ideas on the subject of the administration of a general mess, based on an experience of more than two years and a half on the battleship *Missouri*. I assume that there will be differences of opinion as to some of the views advanced and that some of the statements necessary to show things in their proper relation may be considered trite; but the *Missouri* has furnished a striking example of what active and cordial co-operation between the commanding, executive, and commissary officers can do toward improving mess conditions. This co-operation successfully culminated in inciting the pride of the men themselves to the point of aiding, a result vitally necessary in any general mess. Though of course it is not claimed that anything like perfection has been reached, it is believed that the *Missouri's* experience, at least, can form the basis of a profitable discussion as to certain details of practice upon which there is now all too little unanimity of opinion, considering the importance of the subject to the general welfare of a ship's personnel, and hence to her military efficiency.

The practical administration of a general mess naturally divides itself into three separate though interdependent parts: namely, the *procurement* of food, its *preparation*, and its *service*. Concretely illustrated: every one knows that when poor eggs are bought, all possible skill in cooking and art in serving cannot remedy the original fault in purchase; that the best dish may be ruined in the cooking; or that food meant to be warm but which reaches the tables cold, or is otherwise poorly served, is sure to be far from satisfactory.

The service of food, reaching to the farthest corner of the decks, and involving messmen doing other ship's work, must necessarily be under the supervision of the executive officer. Yet food service forms such an important link to his work that the pay officer must take great interest in it. This interest will be well repaid, for no part of the work of a general mess requires such constant and minute attention. Toothsome dishes left standing about the decks until the grease, the man-o'-war's man likes so well hot, has become clammy, or food served in soiled, chipped ware, will invariably reflect upon the galley. With the right given him to bring directly to the commanding officer's attention any matter affecting his department the pay officer can exercise enough influence over food service for his needs. It is hard to conceive any matter more directly affecting him than the posible ruin of the food he is responsible for. On his side, the executive, desiring a happy ship and realizing the importance of a satisfactory mess in attaining that end, will be glad to have the suggestions and aid of the commissary officer, while reserving the right to decide on questions involving changes in methods outside the galley and affecting other parts of the ship's organization. The result will be that the pay officer will keep in close touch with the methods of food service and will constantly be consulted about them. It cannot be too strongly insisted upon here that it is the *details* of this service that count most, and that too much attention can hardly be given them.

By taking up the subject of food service before that of preparation or procurement, our discussion can be made more clear.

FOOD SERVICE.

One of the reasons why this branch of the work demands special attention is that its smallest details being under the daily observation of the entire ship's company, its perfections and faults are peculiarly subject to remark, and tend strongly toward creating or hindering that feeling of pride in the mess which is such a factor in its success. If the men are proud of their mess they will uphold it and pardon accidents in a general spirit of contentment. Nothing so thoroughly impresses them with its efficiency as the evidences of daily attention to food service.

The material equipment of the mess is necessarily the first

thing to be looked after. Most of this falls under the cognizance of the bureau of equipment, and it may be here stated as my experience that the bureau has met all suggestions with an "open mind" to a degree unusual either in naval or business life. No one could foresee, however, all the improvements which the establishment of the general mess system would bring in its train. Many have had to be worked out experimentally, at navy yards and on individual ships, before being officially approved.

For instance, simple as it now seems, it took actual experience to show that the benefits flowing from the formation of the general mess were due to the fact that work was simplified and diminished by centralization. The purchase and preparation of food was centralized, but the same principle was not applied to its service. This was left to persist under the traditions of the individual mess system. At the present time the fiction of individual ownership and care of mess gear remains, each man being required to supply his own. On most ships one may still see about the decks the open mess-lockers of the old system, wherein are freely exposed all the table garnishings and equipment.

Experience with the actual workings of the general mess has inevitably suggested the advisability of centralizing the work of food service. Objections to the old system were not far to seek. In the custody of messmen, gear was not really clean, neither could it be expected to be. A man of the lower ratings, too often selected on account of his inability to do anything else, was relied upon to keep it so. His meager allowance of water served out from the galley, was hardly more than lukewarm after carrying it to his mess and putting a few dishes through it. He had then to dry his gear with a towel which, being used for all sorts of odd jobs, cleaning tables and what not, the most strenuous efforts of the master-at-arms could not make him keep clean. Let any one on shipboard where messmen wash their own dishes, take occasion to examine the plates on the table. Most of them will show the concentric rings left upon them by a greasy towel, and scarcely any will look or smell really clean.

Again the washing of dishes at the tables was objectionable. It kept the decks more or less sloppy and untidy for some time after each meal. Why could not this be done as in hotels, or in passenger ships, in one compartment especially adapted, thus

letting decks be cleared and tables up as soon as the men finished eating?

A vital objection to the old method lay in the keeping of the table garnishings, such as butter, molasses, vinegar, and catsup, constantly in the neighborhood of the tables, usually in open lockers with the knives, forks, and dishes. Until recently these condiments had to be kept in open cups or bowls, no special covered vessels being furnished for them. When the objections to exposing these articles in such surroundings were pointed out, the bureau of equipment promptly approved requisitions for covered receptacles, and soon after issued generally a standard set for condiments. It is a striking evidence of the callousness induced by long-established custom that determined opposition to this practice had not before been raised. Uncovered butter, molasses, and catsup in confined apartments where men work, fire guns, lounge, smoke, undress, and sleep, should not be tolerated either from a sanitary or a cleanly point of view; yet for many decades this has been the practice aboard ship.

These objections to the old system found answer in the idea of centralization. Once defined and connected with the other parts of the general mess system, development became rapid. A "pantry" was needed where all dishes could be received, washed by modern methods under undivided supervision, and kept in their own compartment until needed. The deck mess-lockers being thus cleared of the bulk of their contents, the next step was to arrange for the removal of the remainder—the condiments—and thus altogether do away with mess-lockers and the presence of food on the main deck, except during the progress of meals.

A place being found for the dishes, the acquisition of a machine for washing them naturally presented itself. Scarcely a large hotel or restaurant in the country but has one, as do most of transatlantic passenger ships. Imagine any one of these, or any of our officers' messes for that matter, having no pantry, but relying on a system of crockery for each table, which the waiter concerned is charged with washing and keeping constantly in the mess room. Though this may be said to be a reduction to absurdity, it points the case.

The operation of a dishwashing machine is based upon very simple principles. The soiled ware, in wide-meshed wire baskets, is passed through two waters, which for different reasons the

hands could not bear. The first water, which is kept in violent agitation, is made so "strong" with lye-soap or other compound that the grease is cut from the ware as it is immersed by the scouring action of the water. The second water is kept at boiling heat, and, in rinsing, dissolves any remaining dirt, besides heating the ware so that when taken from the water it quickly dries itself through evaporation. The boiling of the gear, thus rendering it antiseptically clean, the avoidance of the use of dish towels, and the labor-saving character of such a machine constitute its virtues.

After examining a number of machines in operation a "dish-washer" was duly installed in the *Missouri* in February, 1904, shortly after commissioning. It was put in for trial at the manufacturers' risk, the bureau of equipment being naturally unwilling to purchase it without thorough test. This was made under very difficult circumstances, as the ship, like all others, was then fitted with individual mess-lockers, and in her compact design had no proper place for a "ship's pantry." At first dishes were washed in the open, on the upper deck, for the waiting line of messmen, and returned by them to the lockers. Later the machine was removed to a drum room on the main deck where racks were put up and, after the delivery of soiled gear, the door shut on the men at the machine, leaving them to work methodically until serving-out time for the following meal. This was a great step, but, as may be imagined, the space in the trunk about the stack is very cramped and markedly inferior to the spacious "pantrys" on ships of later design.

It was early discovered that the machine was not "fool-proof," though built to stand rough usage. It would not wash dishes automatically. Some slight degree of care and intelligence was necessary to produce results. There were days when despair was perilously near victory, and nights when I scarcely expected to find it whole at daylight, such was the force of conservative prejudice against it among the men. It was damned by the ship's cooks who had to manage it, and the messmen who had to wait; by the captain of the part of the ship, and by those who lost the use of hot water through it. But convinced that the washing of the gear should be done in one place, even if entirely by hand, instead of all about the decks, the cordial efforts of all officers concerned overcame the various forces of opposition, and now,

after two years and over of continuous operation, its presence is accepted as a matter of course.

Another difficulty encountered was that agateware, through losing its heat quicker, is more difficult to dry than china; and, standing rougher usage, it becomes battered when the chinaware punishes too severe handling by breaking outright. So the necessity for another forward step became apparent. It was no less than the substitution of china for agateware. Incidentally this was done at a cost of twenty-three cents per set, for plate, cup and bowl, as compared with a dollar and fifteen cents, the price per set of agateware at that time. What this change means to the men may readily be imagined. It makes their tables look like those of a restaurant. It is not too much to say that the introduction of china has been the greatest single thing done on the *Missouri* towards raising the tone of the mess amongst the men.

Another difficulty was that navy standard knives, forks, and spoons of bare steel and German silver would not get bone dry by themselves. More particularly the knives, after being exposed to strong water, if left wet for any length of time, would stain badly with rust. So thereafter all steel ware was dried with dish towels, after coming from the machine, but under the eye of the man in charge who was enjoined to use clean *boiled* towels each meal.

It was also found that all pieces were not invariably cleaned by the machine. A certain small percentage had to be rewashed, and sticky substances, such as oatmeal, eggs, etc., required extra work and precaution. But the point is that in washing some forty-three hundred pieces after each meal, much labor is saved through the use of a machine, even if from one to two hundred have to be gone over, and especially if all the rest come from the machine aseptically clean. This lack of perfection in the product of the dishwasher requires, however, that a close inspection of the gear be made as it is washed, and insistent care be taken that no soiled gear shall slip through and be delivered to the messmen. The man in charge of the machine should be made absolutely responsible for serving out only clean gear. On the *Missouri* a few trips to the mast made this generally understood, and defined the right of messmen to refuse to receive soiled pieces, and the duty of the master-at-arms to report any messman found serving food into any but perfectly clean ware.

In any routine where the messman is relieved of the custody of his gear, and particularly where it is all turned in to the pantry, to be piled indiscriminately on shelves between meals, as is necessary on the *Missouri*, through lack of proper space, a system must be established for placing blame for loss or breakage where it belongs. Undoubtedly the best plan, where room permits, would be to furnish each mess with a set of mesh baskets with interiors so arranged that the soiled gear, when scraped and stowed in them for return to the pantry, is ready to put into the machine. Much handling would thus be saved as well as much counting, for a glance at each basket would show any vacant places. With such an arrangement the messmen would have to make more trips to and from the pantry in carrying the loosely packed baskets, but much time would be saved at the pantry itself and the chance for breakage would be greatly reduced.

Disposition for this cannot be made on some of the older ships, however, where it is necessary to count the gear whenever it changes hands in order to prevent the steady leakage found to occur the moment responsibility for it becomes divided. With such a number of pieces there is difficulty in doing this accurately, but practice renders the dishwashers very deft. A certain amount of loss is to be expected and must be excused. Counting fixes the blame in most cases, exposes any unusual catastrophe, and impresses all concerned with the necessity for carefulness.

The average loss is reduced to a very reasonable figure if the dishwasher is required to report after each meal the messes that are short, and if the commissary steward takes a weekly inventory as a check on the dishwasher. It is well to keep a certain amount of plates, cups, steelware, etc., in stock in the ship's store, for sale at cost (about ten cents each) to such as prefer to replace careless breakages rather than go on the report. Very few men are unwilling to make good their shortages when pay-day comes.

It is desirable to have on board a certain amount of agateware and a number of ordinary dish-pans for use with landing parties. China is too heavy for this purpose. The dish-pans are desirable for the rare occasions when the dishwashing machine is shut down for painting, repairs, etc., and the dishes are washed by hand in the pantry.

Below is a set of orders which will indicate some of the details of the work in the pantry:

ORDERS FOR PANTRYMEN.

Refuse to accept any gear not well scraped with bread.

Count gear turned in from each mess and report in book at pay office after each meal.

Wash steelware first; baskets to be not more than one-third full.

Wipe steelware at once after washing; using clean, *boiled* towels after each meal.

Keep *three* full baskets drying on deck during washing, and handle gear on shelves with *clean* hands.

Wash mess- and galley-pans after washing mess-gear.

Keep grease constantly skimmed off water in tanks during washing; keep water in rinsing-tank *boiling* hot.

Serve out no gear earlier than *forty-five* minutes before meal is piped.

Serve out CLEAN *gear only. Replace any soiled or greasy gear turned in with clean gear. You are* RESPONSIBLE *for condition of gear served out.*

Wash out machine with clean water after each meal. Under way, secure dishes with screens over racks. Keep house shipped over the motor.

These orders shall not be varied without specific authority.

The above leads us to a change that is desirable and practicable in the current methods regarding mess-gear. Under present regulations and practice, each man is supposed to bring his mess-gear with him to the ship, and, if he has not a full set, to complete it by purchase from small stores. This is turned over to his messman who keeps it with those of others in the mess-locker. Theoretically, losses are to be replaced through purchase by the one responsible for them. As a matter of fact the gear gradually diminishes in amount until it reaches the minimum with which the mess can get along by sharing the use of spoons and knives, and using bowls, cups, and plates indiscriminately. In contrast, a ship's pantry, regulated as above described, keeps constant track of all gear, so that shortages may be replaced as they occur. With this pantry even the theory of individual responsibility must of course be abandoned. One must either hold the messman strictly responsible for losses, and give him opportunity to re-

A MESS BOX AND ITS CONTENTS. ON THE LEFT A BASKET USED IN THE DISH-WASHING MACHINE.

place them, or replace them for him by using funds provided from the profits of the ship's store. In strict justice, neither of these methods should have to be depended upon, because there is a certain percentage of loss and deterioration in messgear, as with everything else on shipboard, which is unavoidable and incident to the service. This principle is recognized in the practice of allowing officers' messes a yearly percentage of loss on the ware issued to them.

The proper procedure, and the one we must come to, is to treat the general mess in the same way, issuing it a full set on commissioning, and allowing a certain reasonable yearly percentage to cover loss by breakage.

Apart from the ware from which food is eaten there still remains that for the condiments, as well as other mess furnishings, to be looked after. These include vessels for butter, syrup, vinegar, and catsup; also salt-cellars, pepper-shakers, mustard-pots, bread-knives, ladles, can-openers, bread-boards, etc. All condiments should be kept off the mess deck to protect them from dirt. On the *Missouri* a place in the general mess issuing-room was found in which to put all this gear if it could be properly packed, and finally a "mess-box" was devised which proved most successful. It is of light galvanized iron with the mess bread-board used as a sliding cover. Its interior is fitted very simply with clips for the pitchers and rings to fit the bottoms of the butter dishes so that its contents will stand any ordinary handling without capsizing. Each box contains a full set of accessories for two tables and has room for a jar or so of preserves, canteen mustard, or milk, in case the mess wishes to indulge from the ship's store. It can be carried easily and is plainly numbered outside.

The boxes are provided in the general mess isssuing-room, the compartment in which all broken packages of provisions are kept, and which is the commissary steward's headquarters. They are served out before each meal and returned just after; are inspected each time they are brought back, and if not absolutely clean, refused admittance. As the masters-at-arms are instructed to allow no mess-boxes about the decks between meals, except for a short while after breakfast, while they are being furbished up for the day, it is distinctly "up" to the messmen to keep them tidy.

Incidental to the benefits to be derived from the use of these

boxes, and their systematic inspection in one place, is the ability to serve butter cold for each meal, and to mix mustard evenly for all hands, details which have heretofore received practically no attention.

Of course mess-box gear is subject to accidents similar to those of the dishwashing compartment, but the method of controlling and replenishing losses in the latter will apply equally well to the former. For this purpose it is well to carry in the ship's store a small stock of the articles found in the mess-boxes.

The accompanying illustration will show better than any description the character of a mess-box and its set of accessories for two tables. It is from a photograph taken of one in daily use on the *Missouri*, each piece of which has been tried out by experience. On the left is shown a typical dishwasher basket piled with crockery ready for the machine.

ORDERS FOR MESS-BOXES.

Inspect as turned in after each meal; refuse to accept any not in *clean* condition and ready for inspection; report any undue delay in turning in.

Keep daily record, for report, of losses from boxes, and who is responsible for them.

Provide all boxes in the general mess issuing-room.

Allow nothing but perfectly fresh, clean material in boxes; in the case of butter be careful to have it *hard* when boxes are served out.

Serve out no boxes earlier than *forty-five* minutes before meals are piped.

Before taking leave of the question of mess-boxes, it may be well to add that the set of table accessories now furnished by the bureau of equipment is in need of modification. The vessels to hold condiments are not adapted to the boxes, having been designed to stow in the more spacious mess-lockers. The syrup- and catsup-jugs seem to have been given their awkward shape to avoid danger of being capsized. Their broad bases and high narrow necks make them hard to clean and awkward to handle at table. On board the larger ships, at least, there is rarely motion enough to affect the stability of pitchers or jugs of the con-

A MESS TABLE SET WITH CHINAWARE AND "MESS BOX GEAR." A MESS BOX IS ON THE BENCH.

ventional coffee-pot shape, especially on swinging tables. In the boxes they are kept from disaster by clips and close stowage. I have found that pitchers having a capacity of a little over a pint, with covers without springs, simply but firmly hinged upon them, serve best. Vinegar should be kept in glass, preferably with a "squirt" top, as it corrodes metal and is used only in small quantities. Pepper and salt should also be in glass shakers. With the usage they get, glass serves as well as metal and looks very much better. The standard mustard-pots,—small butter dishes,—take up too much room for their relative importance in a mess-box. An ordinary china mustard-pot serves perfectly. The standard covered butter dishes now furnished are excellent.

The bureau of equipment also issues tureens and platters to carry food from the galley to the tables, and to be placed on the tables. These are naturally designed to contain in most cases food enough for one table only. Where this is true, it results in increasing the number of trips to and from the galley and adding to the time required to serve a meal after food once begins to leave the heaters. Time just at this point is most valuable as we shall see later. Further, these tureens and platters are of agate-ware. They are attractive in appearance when new but rapidly chip and become unsightly with the hard usage they receive. For the rough service between the galley and the messes, block-tin ware is much better, and can be kept scrupulously clean no matter how battered it becomes.

Personally I believe it is not advisable to put food on the table in central dishes and let the men help themselves. It takes but a couple of minutes to serve the portions into the plates, saves much wrangling, keeps the table more clean and unincumbered, and, most important of all, saves waste of food. The messmen soon get expert in serving individual portions satisfactorily.

The foregoing description of conditions on a particular ship may serve to show what may be done without a proper ship's pantry. Also, how much these conditions could be improved if the designs of all future ships included a pantry of proper shape and size. This need not be very large, though it is probable that no other equal space would contribute so much to cleanliness, comfort, and contentment. Such a pantry should be a tiled compartment amidships on the main deck with doors to starboard and port. A line of messmen could deliver

the gear in baskets, ready packed for washing, at one door, to receive it at the next meal-time from the other, after it had passed through the machine and been carefully inspected. A communicating door could lead to the issue-room in which are kept the mess-boxes in racks and the stores with which they are replenished. Its equipment should also include a cold-box for butter or anything else it might be advisable to keep chilled. In such a pantry all the work of keeping table-gear in shape, washing, polishing, and providing, would be done behind closed doors, with the maximum of cleanliness, and the main deck would be entirely free of all such routine.

Next after cleanliness, achieved as outlined above, comes *celerity in service*. Every one realizes that the times for meals should not be changed when it can be avoided, but it is also important that *no more time than is absolutely necessary should elapse in getting food from the galley to the table*. The whole organization of messmen and the routine for serving out to them, should center about this point. All preparations should be made at the tables before the messmen go to draw their rations, and the serving out should be arranged so that the most essential parts of the meal leave the heaters last. All serving out should be held off until the last moment possible to allow just time and no more to get the food on the tables before the meal is piped. With a conveniently arranged galley, the cooked part of an ordinary meal for seven hundred men can be served in four minutes, as is demonstrated every day on board the *Missouri*, where two minutes are allowed for the last man served to get below and ready. Where mess strikers are not available to draw the tea or coffee at the same time the messmen are drawing the solid food, it is advisable to serve out the coffee or tea before the other, as it keeps its heat in mess pots long enough to make little difference. Indeed served out at boiling heat any time less than twenty minutes before the meal, it is found to retain its heat sufficiently, except in very cold weather.

Of course even the most efficient routine governing the movements of messmen for three-quarters of an hour before each meal would be of no avail if the food in the galley was cooked ahead of time and held, growing stale till the appointed moment for serving out. It is here that food service and food preparation touch.

FOOD PREPARATION.

In the galley, as on the mess deck, the essential requirement is attention to details. More preliminary work has to be done in the galley, however, to prepare for a modern organization. Much long-established usage has to be broken down and many changes in arrangement of equipment made before a proper routine can be started.

Even before the material has been altered to produce the greatest uniformity, cleanliness, and rapidity in cooking, the personnel of the galley and bake-shop needs taking in hand. Strange as it may seem, much actual instruction in cooking is necessary. Many slack methods must be condemned, and much has to be done to break up the traditional idea that the first law in the galley is the cook's convenience. Appreciation of the fact that food must not be ready till time to serve is one of the final lessons.

It must not be forgotten that, as a comparative innovation, the general mess inherits from the old régime many of the navy cooks in whom years of practical independence in their own work have bred much carelessness. Sometimes disciplinary measures are necessary to correct lazy methods. Examples are, the practice of cooking an entire meal in time to serve early messes and then allowing the food to dry and go stale by the time the regular meal hour comes, and that of serving thick slices or chunks of corned beef which has been removed from the ice-box so long as to become soggy. Ice-cold, tinned corned beef, sliced thin, is delicious, and a very different dish from the "canned willy" which deserves so many of the jokes leveled against it.

The watch-word in the galley should be "*Serve warm dishes* HOT, *and cold ones* COLD," and "*No* STALE *food*." On these hang all the galley laws. Meals timed to the minute, and steaming on the tables are no more an impossibility in the navy than elsewhere.

The material equipment of the galley and bake-shop usually has to be considerably altered to insure the maximum thoroughness in methods of preparation and celerity in serving out. The galley must do its part toward saving time between range and tables. The first step, and a long one, is to establish a freely moving serving line for the messmen, and if possible to banish them from the cook's enclosure by arranging to have them served *outside* the galley. This leaves the cooks the unrestricted use of their

compartment, and gives no excuse for not keeping it clean at all times. Where possible, messmen should be formed in line outside and served through windows and doors by the cooks standing inside. On the *Missouri,* the solid food is passed either from or over the copper kettles, through the galley bulkhead, to the messmen lined up on the upper deck, while a pipe ending in a pair of serving faucets is led from the coffee urn through the bulkhead. These simple changes make it possible to delay serving out a meal until six minutes before it is piped. This, with all it implies, has only to be compared with the usual practice to give a realizing sense of what can be accomplished by systematic food-service applied to the general mess idea.

The ship's cook has always kept a clean galley and been neat in his person, so he will not give much trouble on the score of general neatness. But often he does not really care as to such matters as whether he is serving tea into pots containing more than the dregs of morning coffee, or if the mashed potatoes are filled with blue lumps that the old-fashioned pounder has failed to reduce. So he has to be given a routine which requires all pots to be inverted before going under the faucet; and he needs to be furnished with a patent potato-mashing device whose operation requires a plunger to force all potatoes through eighth-inch perforations in a galvanized cylinder.

It is hardly necessary to state that rigid inspection of all vessels into which food is served is of primary importance. If not presented by a messman in scrupulously clean condition he should be turned down without appeal, thus losing his place in line, and several of the precious minutes he has to husband so carefully. With mess-boxes served out forty-five minutes before the meal, mess gear, say, at thirty-five, coffee at twenty, down tables at fifteen (" mess gear "), and food at six minutes before, the messman hasn't much time to rectify mistakes.

Besides the potato-masher referred to there are several devices which may be used to insure proper and rapid methods of preparation on the part of the cooks. It is difficult to get several hundred pounds of meat sliced evenly at a time,—in fact it is next to impossible of accomplishment by hand, though the most experienced and reliable men are employed. Two years ago we

AN IMPROVISED "SHIP PANTRY" WITH A DISH-WASHING MACHINE.

tried to improve the process by connecting a grindstone to the small motor of the meat-grinding machine (now in general use), to make it easy to keep the knives sharp; but it was not until after obtaining an automatic meat-slicer that really satisfactory results were obtained. This little device works to perfection for all slicing of boned meat and removes the personal errors of the cook altogether.

A potato peeling machine, well known in the merchant marine, has recently furnished means for effecting a decided saving in the loss in peeling potatoes, and made the process of handling them much more cleanly.

The meat-grinder is a very useful and compact appliance. In addition to saving labor, being motor driven, it permits the introduction into the bill-of-fare of such dishes as Hamburg steak and pressed beef, which is often very helpful in ports where meat is of inferior quality.

The appearance in the bake-shop of an electrically driven dough-mixer, (like most of the devices named, including the dish-washer, used on the *Missouri* before any of our cruising ships), revolutionized the character of the bread baked on board. Instead of being subject to the vagaries of careless handling, the dough is evenly mixed by an iron dasher revolving in a mixing-trough of the same material. The advance gained in cleanliness is even more than in uniform mixing. Any one who carries in his mind a picture of 'tween decks in the tropics, and the bakers stripped to the waist working over the dough trough, will appreciate the advantages of a mechanical dough-mixer.

A forty-quart power ice-cream freezer proved perhaps the most popular of the *Missouri's* innovations. For that reason alone, it justified its installation. In adding ice-cream, or water-ice, to the fare, at sea or in port, on tropical cruises, it gave the men something tangible to boast of in their mess, and helped on materially that spirit of belief in the earnestness of its administration, which has been referred to as so important an element of success. More directly, the freezer furnishes a means of adding greatly to the variety of the food at small cost. Water-ice may be given many flavors, and it is inexpensive to make. The ice-cream made on board is fully as good as much of that obtainable ashore for the simple reason that (though it is not generally known), both are made of the same perfectly disguised base,—condensed milk.

Some may smile at the association of sailors and ice-cream, but, fortunately for the navy, the day of the salt-horse, rough-living tar has passed. His place has been taken by clear-eyed, intelligent, American youths who are of the metal to endure hardship if necessary, but who know what clean living and good fare are; and they have the usual American notion of the festive nature of ice-cream. At all events, seven hundred such men on the *Missouri* regularly consume from one hundred and sixty to two hundred quarts of it at a time in spite of smiles and musty traditions.

Of course the application of mechanical devices to galley work has decided limits. The very bulk of the articles that must be prepared at the same time excludes many dishes and methods of preparation. Egg-boilers for twenty-one hundred eggs, or a peeler and corer for a like number of apples would seem impracticable. But when they can be employed they also help to teach the cooks pride in careful methods and raise the standard of all work in the galley.

There is, however, a further improvement which I firmly believe can be introduced with great advantage. This is the doing away with the time-honored coal range and "Charlie Noble" and putting in its place electrical cooking appliances. The principal manufacturers of such devices in this country being overwhelmed with business, have not been able to work out, in detail, the requirements of this new field. Obviously, if this manner of cooking is practicable, as evidenced by the steady growth in the use of electrical utensils ashore, nowhere would it be more so than on a ship, where a power installation already exists and where ample reserve of power is constantly kept for an emergency. The first impulse is to dismiss the idea of electrical cooking as being too expensive. That is the current notion, and it may be true for the average citizen who pays the maximum charge,—not the cost,—to the power company for his electricity. But even under such adverse conditions, these utensils are steadily making their way into private houses. In many cases they have advantages which outweigh the question of expense, but in some localities, under favorable conditions, they are even found to be economical. Certainly they do not have to meet rigid competition. It is difficult to conceive a more wasteful appliance than the ordinary range. Besides the loss in preliminary heating and in cooling after use,

in operation only the merest fraction of the heat produced by it is applied in cooking. In electric cooking the heat is applied or removed at will and at precisely the points desired. Practically none is lost through radiation or in preparation.

Such a plant in a ship's galley would have great advantages. It would improve the cleanliness of all the processes of cooking. It would eliminate the dust arising from the bituminous coal now used. The great heat too common in the confined spaces of many of our galleys, a heat which actually bleaches out the men in warm weather, would be obviated. It is even possible that such a galley would require a steam coil on occasions in winter. Lastly a decided saving in space could be effected, the estimate being that electric appliances would not occupy more than half the area of the present type of range. This would mean much to a small galley.

It is not proposed to substitute any devices for the steam cookers and kettles now in use. They are excellently clean and serviceable, being better for all boiling purposes than any others. Their presence is required also as an alternative means of cooking in case of accident and temporary repairs to dynamos, circuits or electric cookers. A sufficiently varied bill-of-fare for several days can, if necessary, be turned out with the kettles alone.

In recapitulation of this branch of the subject, a set of standing orders for the galley may as well be added.

GALLEY ORDERS.

No one but ship's cooks to be allowed in galley while cooking and serving meals.

No Stale Food.—Time all cooking to be ready at time for serving out, not before; cook food for early messes separately.

No Cold Food.—Serve out all warm dishes *hot;* and not till *six* to *ten* minutes (depending on meal) before meal is piped. Take every precaution to keep iced dishes as cold as possible after coming from ice-box.

Do not serve out coffee, tea, or cocoa till *twenty* minutes before meal is piped; a cook with a bucket to be stationed at the outlet while serving out. Invert all pots over bucket before filling.

Inspect coffee pots and mess pans, and refuse to serve into any but scrupulously clean ones.

No variation of these orders to be permitted without specific authority.

We have now arrived at the more technical part of the subject which relates to food procurement, purposely placed at the end of this article on account of the less general interest of its matter. It forms, however, an integral part of the subject and an important one.

THE PROCUREMENT OF FOOD.

Most of the food consumed on board ship is furnished as part of the ration. Obtained at navy yards, principally New York, and under careful inspection, it is almost always of excellent quality. The same restrictions in the methods of purchase imposed by law, which so often delay the delivery of stores secured for other bureaus, on other than emergency requisitions, attend the procurement of provisions, especially at the smaller yards. General storekeepers at such stations are not justified in keeping a larger stock of perishable articles than will supply foreseen demands, and it is one of the inherent difficulties of the service that the time and place of the demand for stores for cruising ships cannot always be anticipated. It would be well if specified standard brands of provisions could be immediately procured locally by general storekeepers on telegraphic authority to meet hurry calls.

The ration is excellent. Experience with it shows that it might be amended in minor particulars, but practice varies strangely on different ships. I am not, however, a believer in the present system of issuing the ration. The law and regulations permitting the commutation of rations do not fit the general mess system as well as the earlier scheme of individual messes for which they were designed. Any plan like present commutation, based on an arbitrary value of the ration, and bearing as little real relation to the issues, will tend towards carelessness and waste.

The present practice is to commute up to one-fourth of the total number of rations allowed. Of the three-fourths remaining, issued in kind, in the case of some articles, the amount is ample to meet the total demand therefor. In one or two cases it is largely in excess of all needs. A large part of the fund arising from commutation is, however, used in the purchase of the excess required over issues in kind of staple articles, like fresh meats, vegetables, flour, etc., leaving a comparatively small part of the

A LINE OF THIRTY MESSMEN OUTSIDE IS SERVED WITH THREE ARTICLES OF FOOD BY COOKS INSIDE GALLEY IN FOUR MINUTES.

fund available for the purchase of spices for the galley, fruit, eggs, fish, and various other articles outside the ration. The possible existence of accumulations over all needs which can be legally charged off the books, and the paying out of government funds to the general mess, only to pay back again, constitute the basic objections to the present system. To put it specifically, if a mess is entitled to hundreds of pounds of macaroni over all needs, and has difficulty in coming out even on the allowance of some other article, it is hard to inculcate the idea in stewards and cooks that issues of macaroni must be rigidly limited to actual needs, as in the case where they have to do their best to come out square. Further, without dishonest intent, but solely for the advancement of the mess, the idea in such a case is apt to present itself of some sort of bookkeeping trade by which excess allowances may be balanced against shortages.

Again in illustration, suppose in adjusting a month's business the allowance of meat for issues in kind is found to be overdrawn. Some of it must be paid for from commutation money. Which, the cheaper or the more costly? No regulation could be framed to fit the facts justly in all cases; and yet it is clearly evident that if all the expensive varieties be considered as issues in kind, and all the cheaper be paid for, the general mess will be the gainer by many dollars to spend on the "extras" that count so much towards its reputation. Proper as this result may be, it is not within the spirit of the law.

It is not possible to find any point in the scale of commutation which will fit the needs of the mess exactly, and reconcile all differences between the demand and supply, for the reason that each item in the ration presents its own situation varying from month to month. They cannot all be made to fit where arbitrary commutation and a fixed quantity for rations both exist. One or the other of these elements must be made flexible, and should be so related that the amount available to spend for extras shall depend wholly on the exertions made to keep down the issues.

The solution has been suggested of abolishing commutation altogether, and forcing the men to live on the ration "straight." Possibly with this in view, the subject of an expanded ration is now before Congress. The present ration as designed did not contemplate it. Some articles like spices, necessarily used in cooking,

were left out, the idea being that these could be bought as needed. So were many others of wholesome nature which give the present wide variety to the men's fare and the use of which it would be most unwise to prevent. These include such articles as fresh fish and shell fish, fresh fruit, and berries, fresh and dessicated eggs, fresh milk, potato chips, tapioca, fruit syrup, etc., of incontestable importance.

A proper and convenient solution, which not only removes temptation to extravagances or substitution, but actually supplies an incentive to economy, lies in a system where all rations would be considered as issued, all amounts in excess of needs taken up as gains on issue, and the cash value of such gains would accrue as a fund for other purchases. Whether this could be arranged without Congressional action would probably have to be determined by the proper judicial officers, but it is a sane exit from the present difficulties. No authority would be necessary to stop commuting rations to the general mess if a way could be found to secure the value of "savings" to it. In any event Congress must be called on to expand the ration to include necessary items in case living on the straight ration is contemplated. The establishment of anything but a "blanket" ration, which will include any article of food, without means of giving it elasticity to meet all sorts of conditions, can only result in restricting the fare.

Under a "spend-your-savings" system every inducement would be held out to limit issues to actual needs in order that more might be gained for the general mess fund. Without going too far into accounting technicalities, this plan would do away with the general mess statement. This, while convenient, is anomalous in our system of accounting for stores and is not a success as an accurate periodic check on the condition of the mess. No audit is so unless it verifies all the assets, stores as well as cash, and not many general mess examinations include an inventory, verified by the board, of stores shown to be on hand. This plan would allow inclusion of mess operations in the provision return where they belong. Since the full value of issue in kind has been expended from the Government's standpoint, simpler vouchers than public bills might be conveniently used for expenditures from "savings." With the addition of a regulation limiting the amount of the total assets over liabilities of the mess as shown by cash due under savings,

a certified inventory of all stores on hand to some proper amount per man,—or a fixed amount for receiving ships,—to prevent undue accumulations, and a certified statement concerning outstanding liabilties, the scheme would be complete.

Of the procurement of stores bought from general mess funds there is little to say. With all the will in the world some persons cannot buy as skillfully as others. The rules requiring written bids on large purchases, samples with bids, with insistence of high standards of quality, and always two unconnected bidders on any purchase, are characteristic of any business dealing. Generally, success in buying varies in direct ratio to the amount of "shopping" done. It is very convenient to get into touch with hotel men in any locality in which there is much to be bought; and to avoid as much as possible that most accommodating middleman whose place of business consists of a desk and a telephone with connections to the houses one should deal with direct.

As for the tricks of the trade, these must be learned by bitter experience. After the first delivery of oysters bought by the gallon, under competition, and the discovery that the successful bidder meant "wet" gallon of such dampness that the oysters in the liquor were almost past finding out, one will never again forget to buy his oysters "dry." Then the question of gross and net weight is apt to be most delicate if not settled beforehand. A painfully acquired knowledge of trade discounts is apt to be of great help. Rebates on published tariffs are not wholly peculiar to the railroad business.

In the delivery of general mess stores my experience is that the verification of quantities delivered, provided in the regulations, is not positive enough for the pay officer. The officer of the deck is a very busy man, especially at the time stores are coming aboard in greatest quantities; and he has few men on whom he can lay his hands who possess the requisite knowledge of the weight and quality of mess stores in commercial packages to do the checking. So it often happens that the commissary steward, who, as the man most intimately connected in the procurement of the stores, needs most to be protected in verifying the delivery, is left to check them himself and the deck officer certifies on the steward's say-so.

By far the greater value of stores received on board is not even included in this defective routine. Fresh provisions are

bought as parts of the ration. For the verification of these deliveries the regulations do not provide except to indicate in general terms that it shall be done by the overburdened officer of the deck.

Once, the "system superintendent" of one of New York's largest department stores summed up his experience to me substantially as follows: "An ineffective check is worse than no check at all, for it breeds contempt of the system. A one-man check is dangerous and unfair to the man in exposing him to temptation or possible accusation that he cannot refute. Two men to check, if they be from different sides of the business and not always in the same combination, is best practically. Multiplying checks after that increases cost, makes paper work, and does very little good."

On this theory a simple system of checks can be based for all stores received of whatever nature. The most available man at the time amongst the steward and yeomen on a large ship can intelligently check every item coming aboard and certify to the quantity by his initials next the receipt entry in a book (showing date, quantity, and from whom ordered; price, date, and quantity received). No one is permitted, naturally, to make the check entry in the case of stores with which he is directly connected, though the man interested always does see, for his own protection, that the delivery is complete. Thus a two-man check in varying combinations is successfully obtained. Everyone should understand that his initials stand for a positive personal verification. Occasional personal checking, inspection, and questioning on the part of the commissary officer assure this. On this record all bills can be verified and paid.

On a ship too small to have enough experienced men in the pay force to carry out such a system, the commanding officer might designate by name reliable men to verify all receipts of stores, as called on.

Though there is necessarily some detail in these pages in explanation of its fundamental features, the subject of general mess administration has funds of technical detail not pertinent to an article intended for general service reading, but still important to those most directly interested. There are many advances in knowledge concerning it yet to be made, and much skill in handling it yet to be gained, the readiest way to which should

be through the record and interchange of experience. With this idea, I have ventured to break the ice, and what little I can add in experience will be done gladly in case it is desired in direct correspondence.

In the meantime, if this article emphasizes the importance of further *systematizing* general mess organizations, *especially with regard to food service*—and results in an inquiry into many present methods, its main point will be gained.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WANTED: A SYNTHETIC WIRELESS.

By COMMANDER B. T. WALLING, U. S. Navy.

". . . . but information service is *sui generis*, with an importance all its own. Speed, and size to maintain it in a seaway, are the prime requisites, *supplemented by powerful wireless apparatus*, and enough battery to prevent being driven off by torpedo craft." "Gleanings from the Sea of Japan," by Captain Seaton Schroeder, U. S. Navy, Second Honorable Mention, Proceedings U. S. Naval Institute, March, 1906.

But a few years ago Marconi demonstrated the practicable application of wireless telegraphy to commercial use, and almost immediately the new discovery, like its cousin-german, the telephone, rose over our horizon as a to-revolutionize-the-world agent; since that time hundreds of quirks and quips have been rushed into patent rights.

From all of these ideas there should be, there must be, some practicable combination in a finished apparatus which will satisfy the definition of "powerful," and this practicable combination Mr. A. Frederick Collins, the inventor of the wireless telephone, calls a "synthetic" wireless apparatus.

His abandonment of hope—almost a wail—of any such happy result during the currency of existing patents, unless a wireless trust can be formed to absorb and organize them, is recorded in the following extract from his article in *The Electric World and Engineer*, July 30, 1904, and applies equally now:

"Recently the writer had occasion to review the entire series of United States patents granted in the class of Wireless Telegraphy, and the accumulated data indicated plainly that a prodigious amount of time, labor, and money had been expended in the direction of improving the devices used either for the purpose of effecting longer distances, providing greater accuracy or for obtaining selectivity. It is obvious that the great majority

of these patents are for *imaginary improvements*,[1] and that many of these are merely '*paper*' *inventions designed to forestall some unforeseen advantage which, in the adoption of new means for the attainment of Wireless, may at any moment become an essential factor.* . . . . Those who have made even a casual examination into the merits of the *different systems of electric wave transmission* must have observed how each seems to hinge more or less upon some *specific feature*, which in itself may represent the acme of progressive excellence, while *the constituent elements forming the balance of the equipment are either of such antiquated or inferior design as to materially weaken the service of the entire combination.* . . . . by the time the original patents have expired and electrical manufacturers can select the best that the wireless workers of to-day have so nobly striven to produce *then shall we have a wireless system approximating the efficiency and certainty, to say nothing of range and selectivity, that the present telephone system represents.* . . . . *a synthetic arrangement* which should give (*a*) a maximum distance with a minimum energy, (*b*) accuracy, (*c*) speed, (*d*) certainty of operation, (*e*) simplicity of adjustment, and (*f*) a commercial apparatus satisfying the demands of those who use them."

Mr. Collins thereupon goes on to select out a "synthetic" system from the various patents existing in 1904, but with especial reference to shore use; his enumeration of the good things are:

Transmitter.[2] "(1) A motor, (2) an alternating-current generator (after Fleming), (3) choke coils (De Forest), (4) sheet-metal screen, (5) Morse key (De Forest), (6) transformer (Fleming), (7) compressed-air spark-gap (Fessenden), (8) oil condensers, (9) adjustable condensers (Braun), (10) oscillation transformer (Braun)."

Receiver (for resonant receptor). "(1) . . . . the primary of a small transformer connected in series with the aerial and earthed wires, (2) the secondary of the said transformer, which also acts as an inductance coil, (3) adjustable condensers of the mica and tinfoil type, (4) a liquid baretter, (5) a dry cell, (6) a syphon recorder."

This synthesis for 1904, Mr. Collins would probably alter somewhat in 1906; and, for naval use, on board ship, amendment should be made by omitting the syphon recorder and the baretter, or any type of electrolytic cell.

ILLUSTRATION OF AN EFFECT OF SYNTHESIS.

Experiments were made at Culebra, lasting over nearly two years, in an effort to increase the efficiency of the plant installed

[1] The italics of the quotation are the author's.

[2] The notation used is: receptor, the coherer or cell used; receiver, all the assembly necessary to the receptor including aerial; transmitter, all the assembly for sending including the aerial.

at the wireless station in that island. The original installation was for communication with the wireless station at San Juan, an all-water transmission of 47 miles; incidentally the station was to communicate with vessels at sea within the range of its capabilities. The plant is of the usual Slaby-Arco type, operated by a storage battery at a potential of 65 volts. The source is a 3 K. W., 125-volt, Crocker-Wheeler, direct-current dynamo driven by a 6 H. P. Nash (gasolene) engine. The interrupter is of the turbine type, motor driven; receptor, a coherer of the usual Slaby-Arco type; aerial, a fan of six wires in parallel, spread between two masts, wires connected at the bottom, and the "rat-tail" wire of the apparatus connected to this junction.

Up to June, 1904, the best performance of the transmitter was about 108 miles, though no opportunity for good test had occurred; the coherer had, however, on one occasion detected a ship in the Mona Pass, about 112 miles. As there was no "good" coherer at hand at this time, a microphone, consisting of three needles resting on a block of gutta percha, was substituted for the coherer, after which messages were read at a distance of 200 miles without difficulty. New coherers were obtained, but the microphone proved so much more efficient in constancy of results that they were abandoned. In January, 1905, a test of apparatus was made off Culebra by the *Illinois* and *Kentucky*, the opportunity being availed of to test the capabilities of the plant, resulting as follows:

Extreme distance of intelligible transmission		118 miles.
" " " " reception (microphone)		203 "
" " " " " (coherer)		112 "

The transmission required a dangerous discharge from the storage battery, 34 amperes, and hard strain on the Leyden Jars. The probable greatest safe output appeared to be about 25 amperes for a transmission distance of about 105 miles and to this distance transmission of messages is limited.

At the date of this experiment there was in course of construction an improvised, home-made Schloemilch Electrolytic Cell, but it was so crude and the solution so inexact that it failed to improve matters. The limit of receptivity of the microphone having been reached, effort was turned to the improvement of the cell. A small bottle was obtained and partially filled with dilute nitric

acid (7.3 parts acid, 26.2 parts rain water, water in commercial acid being allowed for); the cork was fitted with two platinum electrodes taken from the leading-in wires of an electric lamp; the anode was scraped with a knife to the limit of rupture. Using a head telephone and improvised resistance with this cell there was an apparent increase of receptivity distance to 300 miles; a short time later a potentiometer was connected in, the six wires of the fan aerial divided into two parts of three wires each, and messages were distinctly read which emanated from the *Cleveland*, at Sanchez, San Domingo, and from the mail steamer when from 400 to 500 miles distant from San Juan. Some further adjustments were made and an anode "point" of platinum, 1/5000 inch in diameter, was substituted. From this time on, under favorable conditions, messages were read over distances of from 1000 to 1400 miles, emanating from Wellfleet, Mass.; Hatteras; Galilee, N. J.; St. Augustine; Guantanamo; Colon, and Key West, and so continues; the present difficulty is an insufficiency in number of wires in the fan of the aerial to ensure continuity.

This illustration undoubtedly proves:

(*a*) That the Slaby-Arco transmitter, having a range of but 105 to 110 miles is of antiquated and inferior design, however efficient at the time it was selected (and in view of circumstances under which it was selected), and meets no part of a definition of "powerful."

(*b*) It will be noted that, in the end, the salient parts of the Slaby-Arco receiver are obliterated; only the tuning coil remains, and this may be characterized as probably the best mechanical construction of the type extant. The demise of the coherer, due to its readily breaking down, decadence in use, and lack of sensitiveness, relegates its probably future employment to call-bell use, for which no good substitute is on the market.

Mr. Collins' dicta leave us no room to doubt that we are chained and manacled to a "system"; because each important inventor aims to avoid royalties and secure the financial benefit to his corporation; and because, the immutable decrees governing purchases for Government use place the pecuniary responsibility for infringement of patents in a purchased article *upon the official who orders the purchase;* no chief of bureau can be expected to incur that; and no system yet invented, or any improvement thereon, is offered for, or intended for, the benefit of science.

At this point we arrive at a very natural query: Do we possess a system of wireless for ship use which can reasonably come within a satisfactory definition of the term "powerful"?

The author ventures the opinion that the query may be answered in this wise:

As to a transmitter; yes.

As to a receiver; *in port*, yes; *at sea*, may be; for the general case of a ship at sea, very uncertain from results to date.

Query. Over what distance do we require that our communications and information service shall securely carry?

Answer. *One thousand miles* without over-strain, and 500 miles surely, appears to be a reasonable desideratum and expectation under favorable conditions and at night. We should have 300 miles at any time of the day or night with certainty. The adverse element is static disturbance, whose effects may occasion burning out of the instruments, shock to the operator, and confusion of sounds in the telephone. Under good management of an operator messages can be transmitted during static disturbance; on two or three occasions of emergency, messages were transmitted from Culebra to San Juan, working between the flashes of lightning. It is very dangerous to the operator and instruments to attempt to *receive* during local static disturbance; *the apparatus should be cut out promptly!*

Query. Can any of our present apparatus (now installed) meet the desideratum and expectation?

Answer. We can certainly transmit intelligibly for one thousand miles, and have met 500 miles, day service, but the range over which we can efficiently receive is very problematical. The sensibility of a baretter or electrolytic cell depends upon a delicate adjustment of the distance to which the anode wire is immersed in the solution; the effect on that sensibility from shocks, jars, and ship's motion must cause very erratic variations of sounds in the telephone, from normal down to silence. Then, the solution must be fresh, points clean, adjustments and connections good, and there is also a great difference in the "know how" of operators; these, however, we eliminate from the normal case, and point out that an improvement (as regards ship's motion only, it will not relieve shocks and jars) may be made by slinging the cell in gymbals, though it is a rather awkward device for the purpose mechanically.

The " synthetic " receptor for ship's use points to the magnetic—frankly, the Marconi device—which neither shocks, jars, nor ship's motion can disturb: it easily accomplishes intelligible reception over the desired distances.

ILLUSTRATIONS OF SOME POINTS UNDER ABOVE QUERIES.

Information had been received at Culebra that the Atlantic Fleet would leave Hampton Roads on January 18, 1906, and that its standard speed would be 12 knots; preparations were made on the 16th to ascertain how the wireless would perform; the Shoemaker cell was put in, as it was evidently delicate and had given a good report of itself in communications from the *Glacier*, whose messages had been received ever since the dock was off Hatteras.

January 17, 7.30 p. m. (the day before expected date of sailing of fleet), received:

Maine from *Maryland*. Latitude 32-33 north, 66-27 west,

and at 11.00 p. m.:

Maine. Latitude 34-28, fine fair weather, steaming 15 knots south 39 degrees east, magnetic, wind west-northwest moderate.—*Maryland*.

During the night there was much cross-talk between vessels a long way off, amongst which were the *Illinois* and *Maine*, with whom the *Maryland* was for some reason communicating. The *Maine's* call only was heard, but thought to be a signature.

It will be seen that the *Maryland's* messages were received over a distance of more than 1100 miles; and that, though unexpected, the fact that the fleet was at sea, and was probably engaged in some sort of test or maneuver, was surmised at Culebra within 8 hours, and confirmed within 18 hours, after departure from Hampton Roads.

January 18.

Local static conditions during the day and early in the evening compelled shutting down. Messages were first received just before midnight, apparently originated by the *Maryland* and repeated by the *West Virginia* and the *Illinois*, also some words from the *Glacier*. After midnight heard message calls and fragments between the *Maryland, Colorado, West Virginia, Maine*, and *Illinois*. Distinguished that the *Illinois* was sending to the *Maine;* by strength of sound and tuning located the vessels as follows:

Maryland, way east; next *West Virginia*, next *Colorado*,[1] *next Illinois*—which last vessel was relaying to the *Maine*.

It was quite readily assumed, therefore, on the morning of January 19, that the armored cruiser squadron had been spread out to get in communication with the *Glacier* (and dock) and that the main body of the fleet was standing on the straight course for Culebra, probably 750 miles away.

Messages were now received throughout the day and evening without difficulty, and until the arrival of fleet on January 21.

During the night of January 19, a long message was received from the *Maryland*, whose position at the time was more than 1100 miles from Culebra. The greater part of these messages were also received by the *Olympia* in Target Bay.

From plotted positions of the *Maine, Illinois, Maryland, Colorado*, and *West Virginia* it is established that these vessels can transmit 1000 miles under good conditions—and not making effort so to do—many messages emanating from them during the day when 500 miles off were read without difficulty—"coming in strong."

The *Olympia's* receiver, *in port*, was handling the messages easily, but in the fleet it was very different. The scouts were spread out on a predetermined plan which placed them only about 250 miles apart; frequent confusion on the evening of the 18th showed that messages were much mixed; on the evening of January 19 there was great confusion, many ships sending at once, and all coming in to Culebra in a mass of language whose competitor is Babel. Finally, matters improved after the following message:

> To *Colorado*. Please repeat west. Request that when HM is calling *Glacier* that no interference from ships be attempted. The messages this evening from *Glacier* were lost because of interference of other ships to westward. Ingersoll, *Maryland*.

The *Maryland* was at this time nearly 1300 miles from Culebra *and was sending to the Colorado only 250 miles away.*

In seeking a reason for this confusion a test was made from which it was ascertained that there was *no concordance between any two ships in wave length;* here is a partial solution of repe-

[1] The *Colorado* was actually nearest to the *Maryland*. The *Pennsylvania* was never heard from until within less than 100 miles from Culebra.

titions and that the messages "appeared to jump over a ship" (that is, carried 500 miles to the next); the other part is probably due to effects on sensibility arising from variations of depths of immersion of the anode point.

That a receiver presumed to be tuned for 250 miles catches a "jumped-over" message from 500 miles seems to make it unfair as yet to throw very great doubt on the reliability of our receptors; the fairer statement probably is that our receivers have proved unreliable in the kind of practice to which they have been subjected, and that no really good test at sea has yet been made; amongst others, the test of operators, by sending cipher words for example, such as those of the Western Union code; no Western Union code message, sent from Culebra to be cabled from San Juan, has ever gone through the two stations without a number of repetitions.[4]

So we can probably sum up our own position as regards compliance with a reasonable, up-to-date definition of "powerful," thus:

That we have transmitters that satisfactorily come within the meaning of "powerful."

That results in service are not sufficiently well tested to say that the receivers (for ship use) warrant the characterization of "powerful"; but from what is known we are well within our rights when saying, "I hae me douts."

There is a corollary to the subject of good communication and information service by wireless, in the use of that agent for interference with the same service by an adversary, we will say several vessels of a fleet interfering with—blocking is better—the messages from a scout to her friends. On that subject two excerpts from Captain Schroeder's essay are combined as follows:

". . . . but information service is *sui generis*, with an importance all its own. Speed, and size to maintain it in seaway, are the prime requisites, supplemented by powerful wireless apparatus and enough battery to prevent being driven off by torpedo craft. . . . . .

[4] An officer in the fleet made warm opposition to a reflection on operators, saying his ship had the "best in the navy or any where else." Referring this to the late Lieut. Hudgins, whose plane of superiority in knowledge of wireless matters and "intimacy with waves" has been reached by none in the navy—and to which few, probably, will attain—the superlative, "best," was reduced in his judgment to a qualified positive.

If Rojestvenski, upon approaching the Strait and noting the illegible disturbances recorded by the receivers, had kept his wireless incessantly at work, he would almost certainly have interfered and prevented the enemy's scouts from keeping their people posted as to his movements."

From these quotations, for the use of our topic, we cull the following: "Supplemented by powerful wireless apparatus . . . . had kept his wireless incessantly at work, he would almost certainly have interfered and prevented the enemy's scouts from keeping their people posted as to their movements"; this juggling of the essayist's ideas as to cause and effect is believed to be a fair exposition of a principle he desires to enunciate; he has a large following in this in the service, and amongst those high in councils of tactics and strategy.

With all due apologies, the author believes that he is in possession of convincing data, from actual test—and which he is not now at liberty to cite in print—which show that the image is largely clay, and that the *established laws* of blocking are the following:

I. Blocking is a very necessary and mandatory species of tactics, because it makes intercommunication between a scout and his friends extremely difficult.

II. Blocking will not prevent the scout from communicating with his friends, though the blocker has powerful transmitters, sends incessantly and rapidly, and is in possession of the cipher used by the scout and his people.

This was well tried in the actual test mentioned, with the result that the blockers were potted and completely surrounded in a flight of 400 miles.

III. Blocking will almost certainly prevent any reception by the scout of acknowledgment or message from his friends; but this applies only to that scout which is in touch with the enemy; a coherer would promptly cohere against all practicable effects of the tapper; the strong output of the blocker would "burn the points" of a baretter or electrolytic, rendering that type of receptor of little use; similarly, a magnetic would be inefficient, for, although it can be protected by some such device as an adjustable shunt, the use of the protecting device is at the expense of sensibility.

It appears, then, that this scout has but a forlorn hope of hearing the welcome news "information received," the shadow of a

chance of mere accident or recognizing his nearer friends by their type of apparatus; it is a curious fact that an operator, once familiarized, can distinguish between the Slaby-Arco, De Forest, Fessenden, or Marconi by the timbre of the sound, the analogue, in a qualified degree, of that quality by which we recognize the horn, violin, or flute when sounding the same note; it is particularly marked in the case of the De Forest and Fessenden transmitters.

The mission of this scout is to hang on and still hang on, and send, send, send, pushing his information into the atmosphere for a reasonable time (which experiment should determine) with every watt of energy of which his transmitter is capable, and he will be successful!

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A SYSTEM OF INSTRUCTION AND EXERCISE IN FLAG SIGNALS.

By Ensign Wm. W. Smith, U. S. Navy.

Signalling between ships under service conditions is unquestionably the best method of developing proficient signalmen, but often this cannot be done, when ships are alone. Ships are often on detached service for long periods of time, during which the signalmen, on account of lack of signal exercise, become inefficient. Under these conditions some form of signal exercise closely approximating actual signalling would be very valuable in maintaining the efficiency of signalmen.

No form of instruction in flag signals at present in use is entirely satisfactory for divisional instruction, as a division cannot be exercised at regular signal drill, and the men as a rule, although they may know the names of the flags, do not know how to make and answer signals. For divisional signal exercise some system is needed that is convenient to be used in the part of the ship that is used for divisional instruction and exercise.

Signalmen, while being proficient in signals that are made frequently, are, as a rule, not proficient in signals that are not made frequently, such as emergency signals. These signals, above all, require a quick and accurate understanding for quick action. They are seldom given in regular signal exercises and it is necessary for signalmen to be thoroughly proficient in such signals.

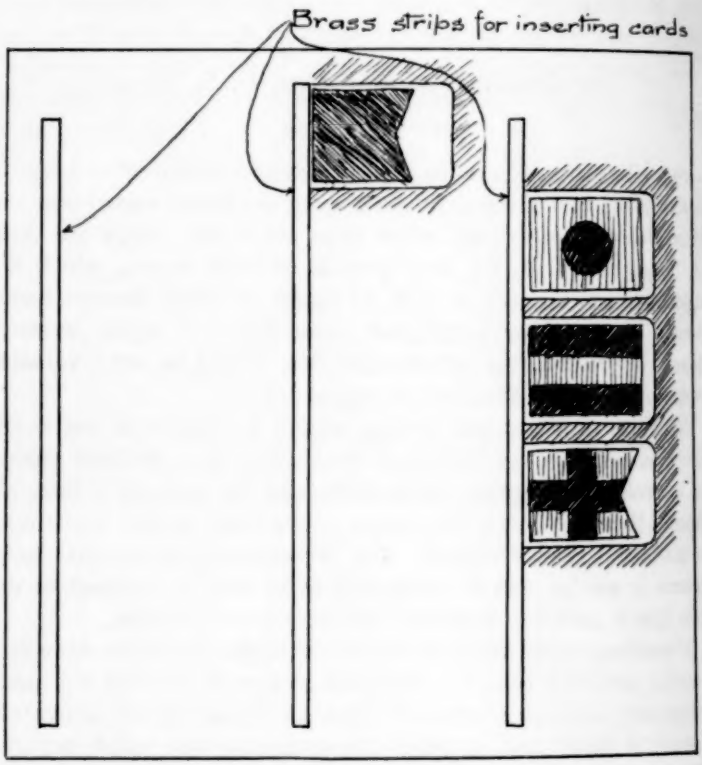
In training and developing signalmen some form of signal exercise is needed whereby signalmen can be exercised at signalling independent of the regular signal drill, for the following purposes:

(1) Developing the proficiency of the signalmen individually by sending and receiving signals themselves. (Signalmen sta-

tioned for bending on and hoisting signals have little time for observing the methods of signalling and usually they learn little during the drill besides the handling of the flags and hoists.)

(2) So that as much signal exercise as is necessary for the development of proficient signalmen, can be had.

(3) So that signalmen can practice signalling among themselves when they wish to.



Hoist Board

The last two apply especially to men, without previous experience in signals, who have been detailed as signalmen. They require more practice at signalling than they receive at regular signal drill, and it is very desirable for them to be able to practice sending and receiving signals and have the methods of signalling explained to them practically. In this way, actually making and

reading the signals themselves, they learn quicker and better than by seeing some one else doing it.

The above are the conditions that exist, and it is the object of the system of instruction and exercise as described below to better these conditions.

DESCRIPTION OF THE SYSTEM.

The flags are printed on glazed cardboard as shown in the drawings. They are the same size, shape and material as playing cards.

Each card has a flag printed on the face of it, and the code and name of the flag on the back of it.

Each set of cards contains:

(A) For signal exercise and instruction.
  (1) Navy Code—Complete.
  (2) International Code—Complete.

(B) For instruction.
  (1) National Ensigns and Jacks.
  (2) Flag Officers and Other Flags.
  (3) U. S. Weather Bureau Code—Complete.
  (4) House Flags of Steamers.

Each set for signalling consists of:

Two sets of flag cards.

Two hoist boards.

The hoist board is as shown in the drawing. It is a board on which brass strips representing hoists are fixed. These strips are made so that the cards can be inserted under them as shown for making the hoists.

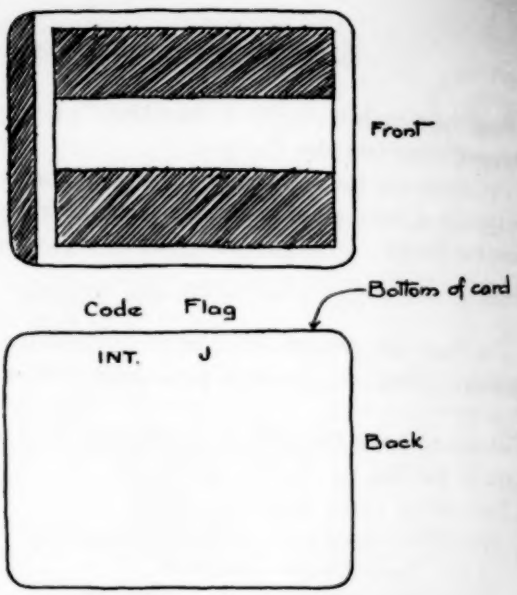
METHOD OF USING.

LEARNING THE FLAGS.

To learn the flags primarily, the cards are run through (the code and name of the flag being found by turning the card over and looking on the back) until each flag can be recognized at once.

SIGNAL PRACTICE.

Sender.—The learner is given a message to send. He looks up the hoists in the signal book, making them on his hoist board, by inserting the cards under the brass strips in the proper order.


Front
Code Flag
Bottom of card
INT. J
Back

The hoists are made in the usual manner, according to the rules for signalling until the signal is finished.

Receiver.—The receiver reads the hoists, looks up the meaning in the signal book, answers on his hoist board and records the signal in the usual way. At the end of the message he compares his message with the one given the sender.

This method approximates very closely actual signalling and can be used at any time by only a few signalmen (two or more). The knowledge of sending and receiving signals and the uses of flags are learned from this system, and this element of the total amount to be learned in actual signal practice is eliminated, making is possible for them the sooner to become efficient signalmen with the usual signal exercises.

Signalmen should be able to recognize the national ensigns, flag officer's flags, the house flags of steamers, and the flags of the U. S. Weather Bureau Code. These flags are included in the system so that by going through these flags signalmen will be able to recognize them at sight.

Briefly, the object of this system is to teach:

(1) The flags.

(2) The uses of flags and codes.

(3) Sending and receiving signals.

(4) Emergency signals.

After the above has been learned from the card system it remains for signal practice to teach:

(1) Handling of flags and hoists.

(2) Reading signals under actual conditions (such as distinguishing flags in the various positions they are blown, against various backgrounds, etc.).

(3) The disposition of signalmen for signalling. And many other such details which can only be learned from actual practice.

Proficiency in signals can only be attained by actual practice, and it is not expected that this system alone will develop efficient signalmen, but it will give the knowledge which is essential for efficient signalling.

The advantages of this system are:

(1) A quick and an easy method of learning the flags.

(2) The uses of flags are readily learned.

(3) It is a convenient method of signal exercise that can be used with little trouble, anywhere on the ship and at any time. In comparison with regular signal exercise, it is quicker, does not require so many men, and the person who is signalling gets the valuable experience of having to do the signalling himself—he has to think for himself and does not merely hoist the flags that are called out to him as is often the case in signal exercise.

(4) There can be as much signal practice as desirable. It is useful in bettering the conditions mentioned above, as follows:

(5) It makes it possible for the signalmen in ships (on detached service) to keep proficient in signals.

(6) Divisions can be exercised at flag signalling.

(7) It is useful in exercising signalmen in emergency signals and other signals not frequently used.

This system of instruction and exercise should be of use not only to those who are learning flag signals but also to those who are familiar with them, by making it possible for them to practice at signalling and keep in mind signals and methods of signalling that are little used, yet are of the greatest importance when used.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A REPLY TO CRITICISMS OF THE PRIZE ESSAY FOR 1906.

By COMMANDER H. O. RITTENHOUSE, U. S. Navy.

The discussion of "Promotion by Selection" shows clearly that in one matter I have been misunderstood. It is stated by more than one of the contributors to the discussion that I am satisfied with existing conditions. Neither in the essay nor elsewhere have I made such assertion. I am *not* satisfied with *existing conditions.* It is our *seniority promotion* that satisfies me and even causes me to rejoice. I am in entire accord with others as to the necessity of having more experience in the higher grades.

This misunderstanding (for which I accept full responsibility) is due no doubt to the remarks found on pages 4 and 5 of the essay, which were intended only as incidental comment to show that *mere age* is not the chief cause of our present difficulties as some have thought. The argument proper ends on page 3, where it appears that selection is not a necessary means for supplying us with younger commanders. There are other methods. We are then, logically, at liberty to show, if we can, by discussing the other divisions of the subject, that selection is such a very objectionable means to use, that it will be wiser to get our young commanders by some of the other available methods. All this, however, is absolutely immaterial as regards the issue between seniority and selection. I have referred to it in justice to others as well as myself lest my silence would seem to endorse views that I do not hold.

The opening remarks of the discussion by Commander Staunton may stand entirely unrefuted if he will permit me to substitute in his first sentence the words "method of promotion" for

his too comprehensive word "administration." It will then read as follows and be true:—"he (the essayist) finds no necessity for change in the method of promotion of the personnel, but, on the contrary profound reason for congratulation in the wisdom, security, and efficiency of the present method."

Considering next his views as to the better way of determining the merits or defects of selection, I am unable to agree with him. The "inductive" method is appropriate to the laboratory where facts are positive, where conditions are carefully noted, where incidental influences may be largely excluded, and where sufficient experiments may be repeated to eliminate accidental errors of observation and management. These essential conditions are almost entirely lacking in the subject under discussion.

He gives with remarkable fullness and facility all the elements of the problem (I hope at least there are no more) and, in effect, asks why I did not solve it. Let us see. I do not know the relative weights that ought to be given respectively to the conditions "social," political," and "military." But, of course, I could *assume* reasonable values for these. After reading some volumes of foreign naval history I might conclude as to the apparent influence selection had exerted upon "loyalty," upon "esprit de corps" and "efficiency," as measured by war achievements. To get at this data correctly I presume it would be necessary to take the war achievements as they stand and note what is left after we have taken out all that might be attributed to causes *other than selection*, such as larger fleets, helpful or harmful accidents, etc.

Then, as my critic happily discerns, we should consider and distinguish between the good kinds of selection and the bad; also take cognizance of differences of race and many other matters. After extending the inquiry to armies should the result be applied directly to naval experience, or ought it first be modified by some appropriate formula of reduction? There is, in my opinion, too much opportunity for "the play of the individual intelligence upon the material for discussion" in the application of the inductive method to this problem.

Personally, I would have much difficulty in excluding extraneous matter, such as remarks on selection that I have heard in the mess-rooms of English ships. In looking into our own naval history for help, in addition to what is suggested to me, I could not

wholly exclude the fact that such modest success as we may rightfully claim has been attained without selection.

Such were some of the difficulties that decided me against undertaking the problem in the manner suggested. That there is a solution along these lines (possibly more than one) I do not doubt; and I wish to add with all sincerity and respect that I know of no one more competent to obtain it than the propounder of the problem himself.

He asserts, in support of selection, that it is in operation in other countries. In some of the leading navies it has been undergoing modification for years, and if the modifications are real improvements, as we may well believe, there would seem to be room for the thought that the less selection the more satisfactory the system. Selection was almost a necessity in the early composition —it can hardly be called organization—of navies. The supply for leaders was merely an untrained and promiscuous body of merchant captains, soldiers, gentlemen adventurers, and seafaring men who sometimes operated without formal commissions. There were no training ships, nor academies, for officers. In these modern times such necessity for selection has passed away, as the product of training schools with their superior methods has become more uniform and refined.

Following his discussion we find on page 31, first paragraph, the unusual incident in the PROCEEDINGS, of a quotation that is both misapplied and mutilated. I trust that any interested reader will turn to page 9 of the essay that he may know precisely what was written and the subject to which it relates. He will there see that the quoted words were used under the heading " Selection as Reward "; that is, *special* advancement for some *specific* act. He naively takes my statement out of the category to which it applies and discusses it under the very different heading of the higher qualifications that naturally go with the places of greater responsibility; a field to which it obviously does not apply. This distinction of headings which is clearly made in the essay is certainly not without good authority, as he himself carefully discriminates between them on page 32 in reference to advancements made while the war is in progress.

To re-establish the argument where it belongs and exactly where I placed it, it is necessary to repeat that presidents, bishops, and all the other eminent people he mentions would most em-

phatically rest under reproach and be stained with immorality if they obtained or were given office merely as "reward" for special and peculiar services. In politics this is known as the "spoils system," and in ecclesiastical matters as "favoritism." No longer in any respectable organization are people given "places" as "reward" for services. "Robust and wholesome experience" in Congress established civil service reform throughout the country for the very purpose of suppressing this evil. When I reflect that selection in the navy would operate as a constant temptation to such ends, I hold harder to my proposition than before.

The additional facts that the quoted words were but part of my sentence, that the omitted part was the very important and definite hypothesis upon which alone any assertion was based, and that my conclusion was erroneously presented as an unqualified statement, are matters of minor consequence to the points at issue. They merely illustrate the mistakes any of us may make when we are interested in a subject like selection.

On page 31 of the same discussion a certain quotation is referred to as an "apotheosis of mediocrity." There is nowhere in the passage quoted any laudation of mediocrity: A high average of excellence is what everyone wants. Don't lose sight of the issue. There is no dispute as to the desirability of leaders. The issue is, *which is the better manner of their supply?* The upper grades of the navy constitute the field of this supply. No one man is "it" and all the others a matter of indifference.

The notion of the man and his pawns is justifiable in *actual war.* War is a crisis, a culmination. When the leader is once designated, all under him, officers and men alike, are prepared to make willing sacrifice for the common good. These sacrifices are not lost to the individual. They become honors and are transmitted to posterity as a prized inheritance. But in the mere *organization* of society to accomplish desirable purposes, such as the one under discussion, *preparation for war,* we do not need the *one man;* we need a goodly supply of *men.* We need these men contented, enthusiastic, harmonious. Each feeling that within himself are the qualities which, coupled with opportunity, may advance him to leadership. Each willing that others may have every equal chance with himself.

The method of the player with his pawns is absolutely and positively inconsistent with the end here desired. It is the very

evil that those opposed to selection would avoid. Who is willing to play the part of pawn in time of peace and merely contribute to the advancement of others? What is his sacrifice worth to himself, to his descendants, or even to his country? Society is organized to-day distinctly on the basis of *men*, and *the man* is no longer tolerated for arbitrary direction of affairs. He is chosen from his associates for temporary service.

The country needs *men* in the upper grades of the navy, and it needs to have them satisfied with their circumstances, and it can have them so only by treating them as men.

Selection does nothing to raise the average efficiency of the service, and but little to raise the average of the higher grades at the expense of the lower ones. Elimination raises the average efficiency of the entire corps, and of each grade in the corps, by every rejection of its weaker elements. By elimination we may cut as deeply as we please to secure that high average of excellence from which we may make safe choice of leaders at all times, whether in peaceful preparation or in war.

Among other things that history shows, is, that about the time of the French Revolution the "pawns" of the world began to come into possession of their own, and there has been improvement ever since. Napoleon's imperialistic and brutal epigram was merely the expiring echo of "L'Etat, cést moi"; and it has undergone almost complete reversal in these days of educated democracy. The principles of plain justice between men that are accepted as the basis of organized governments apply to all subordinate organizations where the personal interests of men are involved.

Because a person is willing to see officers "selected" for detail and assignment to special duties in the naval service but is unwilling to see selection adopted as a *principle of regular advancement* from grade to grade upon the navy list, he forfeits no argument that applies only to the matter of his unwillingness. It is a pleasure to discover here that there is at least one form of selection that my reviewer cannot endure. I think myself that the form to which he refers is the limit and so state on page 19 of the essay. I already have enough selection. He apparently is willing to take further risks.

He then enters upon another subject; that of organizing the personnel of officers. Into this larger constructive problem, in-

volving the proportional numbers in the various grades, providing for the best distribution of experience and other essential matters, it is not my purpose to enter. I carefully and designedly avoided it in the essay. Therein it was my single purpose to show, if possible, that the objections to selection were so serious that in the solution of the important reconstruction problem it should have no place.

Lieutenant McLean has contributed largely and forcibly to the discussion. In replying to what I regard as some of the more important of his arguments I wish first of all to note a peculiarity that he shares in common with many others who support selection. He continually makes appeal for the *efficiency of the service* in *war* as the object to be attained. That is excellent. It should never be forgotten. But selectionists differ in no respect from anti-selectionists in this matter. It is hardly likely that any professional reader of the discussion would be misled by such frequent iteration, but others might easily acquire the mistaken notion that selectionists alone were really solicitous of this important matter. No political party in this country can claim the flag as its own, exclusively; and similar principles govern us here. To show that this is no belated thought of my own, and that I may not passively contribute to error, I refer to the essay: page 1, "best interests of the service"; page 2, "the highest welfare of the service" was made the common foundation of all that might be said by others as well as by myself, and it seemed unnecessary to keep calling attention to it thereafter. On page 13, *war* is distinctly referred to as the "ultimate purpose of all navy work."

Instead of strengthening argument such repetition seems to me, in some slight measure, at least, to betray weakness. Suppose, for illustration, two men in the same boat some distance from their common home port, and conditions being unfavorable they wish to gain their harbor. One urges to set out by the starboard tack, and the other contends for the port tack. In the ensuing discussion one of the parties may believe that he has excellent reasons for his choice. But surely he adds nothing to their weight by all the while asserting that he is *anxious to get home*. It is plainly evident that there is no deliberate motive in the matter alluded to. It is merely an accidental outcropping of the discussion that, in fairness, I think, should be corrected.

Some apparent differences between Lieutenant McLean and

myself would probably disappear by agreement as to definitions. His definition of "selection" seems to me to lack clearness. At least, I am not sure that I understand it. It would not seem to be inconsistent with what I would call seniority promotion coupled with the elimination of those who failed to reach some recognized standard of meritorious qualities.

By "selection," I mean any system whereby regular and ordinary advancements from grade to grade would involve the promotion of people over and beyond those who stand ahead of them on the registered list, while those so passed over are regarded as good enough to yet remain on the active list to do regular duty under those once their juniors. In briefer terms this is "positive" selection; commonly called the "leap frog" system, or "jumping" system. I do not mean selection "downward," nor "sideways," nor "out," frequently so called.

His definition of promotion by seniority would seem by its phrasing to include all those defects of our present methods which have produced "humps" and "hollows" and irregular and unsatisfactory terms of service in the grades. I cannot admit these defects of our system to be charged to seniority. They are evils independent of both "seniority" and "selection." If uncorrected by elimination, by age limit or service limit in grades, a reserve list, or other means, they will prove harmful to any system.

By seniority, I mean a system of regular promotion whereby officers remaining on the active list of the navy are promoted in regular order according to an established list. If an officer is found by examination not worthy of promotion, after the regular term of service in his grade, he is not worthy of the place he occupies, and should be removed.

On page 34 there is a discussion of "inherent personal rights." I agree with him entirely in principle and in theory. And in the exercise of the principles I will go as far as he in subordinating and even in annihilating personal rights and property and interests of all kinds. I will go, I say, as far as he, *until* I reach that *extreme which is dangerous* and beyond which we have harm instead of benefit. For example, I would be willing to see elimination used unsparingly, even in the upper grades, until only those of "shining merit" were left; and the persons so eliminated thrown back into civil life on their own resources, if no less drastic solution of efficiency can be found. I would prefer this to selection.

But all such *extreme* application of any good principle usually brings about its own defeat; and when "inherent rights" are so absolutely disregarded in organizing the personnel of officers, that, in my judgment, the efficiency of the service for war would be impaired, I ask for more moderation.

Personal rights, of course, *all* vanish in that ultimate crisis when war for existence forces the choice between the interests of the individual and the interests of the State. But in *organizing society* and *in organizing* that essential element of society called a *naval* or *military force*, whatever personal rights it may be found necessary to obliterate, there is *one right* that of necessity remains unimpaired and unchallenged until existence itself is threatened. This is the *inherent right to justice*. All oppressions, all favoritism of classes or of individuals, all the wrongs both great and small that make up the subject matter of jurisprudence, find their ultimate definition in the one word *injustice*. Against injustice men will ever protest and rebel. Any system into which it enters by either accident or design is essentially and seriously defective.

The necessity of having experienced flag officers in actual command ready merely to apply additional power to the machinery already in full operation is most forcibly and convincingly driven home by his perfect illustration of the war game. So far as *experience alone* in all the various grades is concerned this must be intelligently provided for whether selection or seniority is adopted for regular advancements.

On pages 43 and 44 arguments are advanced to show that if promotion were based upon the display of superior merit, the resulting competition would increase the efficiency of the service. Athletic and professional contests are referred to in support of the proposition.

A justifiable distinction must be made here. In all such contests as those referred to it is the *honor* and *distinction* of winning in a fair contest that is coveted; not the prize itself. The prize is merely *the token* of success and is usually offered by a disinterested party. If the contest is not based upon even terms there is no honor in the award.

The intrinsic value of the token should never be such that it can influence the purity and fairness of the contest. A spray of laurel was sufficient in Rome. The iron cross, the Victoria cross,

and our own medals of honor are intrinsically worthless in comparison with what they signify.

Men will become exceedingly skillful at cards and other games under the stimulus of insignificant stakes. But if the stakes are their *personal fortunes* all the recognized evils of gambling are at once manifest and the entire society of which they are members suffers injury and dissolution.

In a military service the ambitious officer is justly proud of winning reputation, esteem, and historical prominence by overcoming his country's enemies. The rank that he may thus gain is then the mere incidental prize that symbolizes something greater. But if the contest is to be *for rank itself*, and is to be among comrades, and the prize for which they compete is so valuable as to be an object of gain in itself, then they no longer are striving for honor, but for a material profit. The prize of high rank is esteemed generally by military men as even beyond financial fortune, and among those of excessive ambition, of which the service is never free, the greed and methods of the gambler will prevail. The contest will be unequal, and the course will be fouled by outsiders, friends of the competitors, who are under no restraint to keep clear.

Thus, it would seem, there is an extreme of competition that cannot be practised with safety. Debates in Parliament on fiscal measures show that while limited competition in trade may tend to improve products, yet, if carried beyond a certain point it has the opposite effect and is productive of unsubstantial and deceptive imitation.

Lieutenant McLean makes other very strong points. I do not claim that they can all be overturned. If there were not strong arguments on both sides of this question, the question would not exist. Yet he argues so fairly throughout that without assenting to or denying his other propositions I willingly leave the reader, whose patience I have already tried, to decide as to their merits.

Lieutenant-Commander Key in the March number of the PROCEEDINGS refers to the essay and asks with some impatience, why I do not come to the gist of the matter at once, correct manifest evils and solve the important reconstruction problem. I would answer that I think one reason that has delayed reconstruction is that those who have attempted it, have often undertaken too many things at once, instead of first systematizing data and conditions,

and settling important matters that can be dealt with independently. Believing that the method that should be adopted for regular advancement is one of these matters I confined myself to it exclusively.

I was glad indeed to find among the many good things of his paper a vindication of my incidental remarks concerning the ability of the older officers. He is willing to trust them in the most responsible positions two years longer than is permitted by existing law.

I am further glad that, apparently, he is not so strong a selectionist as are some others. I wish that he would abandon selection altogether in the development of his scheme, and eliminate by retirement, by reserve list for shore service, or some other means, all the rear-admirals regarded as too weak for the higher grade, so that the dignity and orderliness of those high positions might not be marred by unseemly contests, and promotion by seniority be the unbroken rule.

There seems to me something a little inconsistent in his proposed system whereby an officer may go through the various grades without needing the stimulus of the selection spur until he becomes a veteran flag officer and then for the first time it should seem necessary. I think most men of mature years of sound mind and body rise to the demands of high responsibilities when they are naturally encountered in the line of their life training and effort, and I believe the training of naval officers especially qualifies them for such tasks. Furthermore, I see nothing in the energy and activity that characterize our present fleet management to make me think any such stimulant would be of advantage.

I regret that I cannot share the hopefulness of those who are looking for a satisfactory and practicable scheme of *fair selection*. In the solution of a difficult problem, we should understand thoroughly the nature of the difficulty if we wish to overcome it. The essential difficulty of selection is the *inherent element of uncertainty* in the choices it must make: I do not refer here to the immediate and comparatively unimportant fact that by error of choice an incapable man may occasionally be selected or a good man overlooked. These are merely superficial evils, and systems may be devised to meet them in a fairly satisfactory way.

This does not touch the real difficulty, however, which is deeper, and which is rooted in the mere fact of the *uncertainty*

itself. It is this ever present uncertainty (however slight it may be) that constitutes the doorway through which wrong will enter. This door can never be closed. Efficiency and merit *in untried places and conditions* are not facts that can be verified by our senses or by any records. Advantage then is readily taken of this state of affairs to advance unworthy people. We cannot prove a negative. If it is asserted that the aspirant *has* merit who can prove that he *does not have* it? When people of influence in civil life think they see "shining merit" in an individual, it exists without question, and all the selectionists and anti-selectionists combined cannot prove the contrary. The most they can possibly do is merely to assert that they fail to see what others say they do see.

Surely those who favor selection have considered what might happen some day if their own strongest argument should be used against them. Suppose it is asserted by those who make and unmake navies that a certain popular general, or some eminent civilian is the exact man for the hour and the place. Who can gainsay it if his backers claim to see the superior merit in him? And since the merit cannot be disproved it would seem that however much others might complain, selectionists logically would have no cause. If the man *has* the merit *ought he not* to lead? and they cannot prove that he *lacks* it. Therein lies the real difficulty in solving the problem of *fair selection,* and when solutions are offered this must be the test of acceptance.

Both Rear-Admiral Goodrich and Captain Barry give instances of injustice, the mere recital of which, outweighs pages of discussion. The records and unwritten experiences of the Academic Board at Annapolis furnish proof that cannot be refuted of the irresistible power of political and other interests over every barrier of regulation and law that reason can suggest. And these harmful forces are brought to bear in behalf of mere youths with no past record of accomplishment, and whose hopes are in the remote future.

There are existing organizations in close touch with our political system that no doubt feel well qualified to supply the country with leaders for any occasion; and when we need the very best man of all, selectionists will have to answer the question why choice should be restricted to the narrow field of Annapolis graduates.

Whatever differences there may be among us regarding policies relating to the personnel, there can be none as to the value of the sound and thoughtful suggestions contributed to the discussion by Commander Roy C. Smith. It is safe to say that no wide reconstructive measure will be attempted without giving serious attention to his propositions.

In conclusion, I wish most earnestly to express the satisfaction I have enjoyed in the consciousness that my most severe critics have been animated by no motive that did not find its source in their regard for the ultimate welfare of the country, as it is identified with the integrity and efficiency of the naval service. With this deep conviction I am content to leave the issue, knowing that if its decision rests with the officers of the service, whatever the verdict, it will be founded in loyalty and patriotism.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

FOR THE BROADER STUDY OF TACTICS.

By REAR-ADMIRAL C. F. GOODRICH, U. S. Navy.

Writers on military subjects include, among their definitions, one to this effect:

"Grand Tactics treats of the handling of troops on the field of battle," or "Grand Tactics includes the combination of the several arms and the handling of armies in battle."

Now we all know that, besides the three fighting branches of an army, the infantry, the cavalry and the artillery, there are other ancillary bodies, any one of which may turn the scale in action. Thus, the field telegraph might happily connect the right wing with headquarters and enable the Commander-in-Chief to use an important part of his force as if personally present; or the bridge train may be so disposed as to profit by a well planned operation, real or feint, to rush forward and quickly lay pontoons across a stream at a point which proves later to be the key of the whole situation. In battle, nothing is insignificant which contributes to success.

Similarly as to our own service, careful study will show that what we know and call Naval Tactics is but the *minor tactics* of Hawley and Clausewitz and that very little has been done to solve the great problem of how to conduct a fleet action.

It is not my purpose to discuss the great question in these pages, but rather to indicate briefly some points that deserve and demand attention.

As an example, Naval Grand Tactics may roughly be described as showing how A may, at best advantage, attack B, bringing him under A's densest gun-fire and yet minimize the danger from B's torpedoes, etc. The desideration being given, by what means shall A achieve it? The answer can, of course, be simply stated,

"by the use of the helm and the engine." True enough, the tactics of formation are like the alphabet in writing, indispensable; but what is to determine the Commander-in-Chief to perform any particular maneuver, and how shall he carry out his intentions? In other words, in what way, if any, will methods of signalling, of fire control, of external communication, of battery arrangement, of armor distribution, of range finding, etc., affect his judgment? Has he, in his fleet, the analogues of the cavalry, the signal corps, the skirmish line, or the commissariat? If so, what will he do with them immediately before and during action?

It is one thing, for example, to read what Admiral Togo did a year ago, but another to throw light on his mental processes and explain what he had in mind when the ball opened? These are things which we should know if possible and, knowing, keep to ourselves.

As I am extremely desirous of gathering facts, opinions and suggestions, to aid me in my attempt to study this vital subject, I beg to say that I shall be very grateful for any hint or help which my brother officers may be kind enough to send me. The field is too wide to be covered by one man and, in the multitude of counsellors there is wisdom.

It is evident that the standpoint from which the scheme of Naval Tactics must be developed is the standpoint I have indicated—that of the Commander-in-Chief; because it is from that standpoint that our next battle will be directed. Unless we approach the subject from this side we must either remain in our present state of unreadiness or begin a period of aimless, expensive and highly dangerous groping in the dark.

DISCUSSION

The Elements of Fleet Tactics.

Lieutenant-Commander A. P. NIBLACK, U. S. Navy.—In correcting the proof of this essay, which was submitted last December (but which represents some years of careful thought and study), it appears that there are several hazy suggestions which need further definition.

It was *not*, for instance, intended to imply that concentration of gunfire should be on any *one* ship of the enemy but rather on the nearest portion of the enemy's formation, because the chances of hitting and the damage done are something like proportional to the squares of the distances or ranges. Axiom 9 explains that the illustrations and gunfire diagrams are for the *minimum* distances at which *maximum* concentration may be obtained. The fan-shaped areas overlap at long ranges. The illustrations are all for close ranges, but at long ranges all tactical problems are much simpler on account of this overlapping.

Many people will say that the "Special Methods" apparently *advocated* are dangerous, impracticable, and merely *pen* sketches. They are at least worthy of trial and are capable of modification. The writer has never taken the course at the War College and is hence untrammeled by official secrets and unrestrained by the blighting fear of revealing anything. For instance, the writer's views on fire control are apparently not in accord with those now officially advocated and in process of application, but as the whole question of tactics begins where the individual ship enters the formation *prepared* to act in concert with other ships and in obedience to directions from an outside source, it is fortunate that tactical inferences are not vitiated by mere technical details in which the *dictum* of to-day may be the foolishness of to-morrow. In this case the writer is behind the times.

Many officers disapprove of tactical exercises with boats to simulate fleet evolutions. This I regard as fatal, and the sooner we wake up the better. On page 404 it is stated that "we accept fleet tactical drills as a necessary evil without realizing that there are important *tactical problems* to be solved which are as vital and pressing as those which brought about the recent revolution in our target practice methods." Now, the game board and tactical game outfits furnished by the Bureau of Equipment are the "dotter," and the boat exercises are the "Morris tube" of the revolution in tactical exercises with which we now stand face to face. Tactical exercises with ships may consist in handling ships so that nerve will supplant nerves, but tactical problems should be such that when a fleet gets underway to go out and spend a lot of time and coal in solving them, their solution should be as capable of being arrived at as it is

to test a gun-mount or to test the expertness of gun-captains. In other words it should be a competitive test of captains of ships. Will flag officers and captains submit to this? I think not, but until we do, our ships are as painted things on a painted ocean. This is plain language for a plain issue. Let those who opposed and belittled the target practice movement remember that it is better to blow a horn in the front rank than to be forced into the procession and then have to appear very fond of marching.

Successful signaling is essential to tactics. We have a fine code, except for the foolish hand semaphore code, which I hope to see withdrawn in favor of the regular code. Boat exercises will test and perfect signaling. Let us by all means start up the "dotter" and "Morris tube" in tactics.

Commander BRADLEY A. FISKE, U. S. Navy.—It is to be hoped that the essay of Lieutenant Commander Niblack will wake us up to the backward state of our tactics, in the same way that the writings of Sims and Alger woke us up to the backward state of our gunnery.

A careful reading of Mr. Niblack's paper shows that his aim is to call atttention to a subject that is being neglected. He makes many practical suggestions, and proposes several original plans; but these seem intended mainly as supplementing his criticisms of short-comings by offers of remedies to cure them. He confronts us, not with a theory, but with a condition; and a condition that is dangerous.

The Service agrees with Mr. Niblack that we have no scheme of naval tactics, and that we need one. How shall we develop one? Mr. Niblack suggests that we *begin* with steam launches; and it seems hard to imagine a quicker and cheaper way. If we do not get a good scheme, and if we fight a navy of equal strength that has one, we shall be whipped. And we shall be whipped in the way France was by Germany.

How did Germany develop the scheme—not only of tactics but of strategy—by which she whipped France? By carrying on for many years a system of sham campaigns and sham battles. Such excellent experience did these give the German generals, officers, and soldiers, that, when the actual war came, although they had had almost no experience in actual war, they went through the actual war with scarcely a mistake.

Because Germany did this with her army, she can do it with her navy. So can we.

Rear-Admiral WILLARD H. BROWNSON, U. S. Navy.—It is inconceivable to me what governed the Board of Control in awarding the prize in the recent prize essay contest to a paper on the subject which the Service at large had decided against, not only many years ago, but many times; an essay written entirely from the standpoint of the officer and absolutely ignoring the interests of the country; and awarding first honorable mention to an essay on the most vital subject before the Service to-day, that of Naval Tactics. It would be interesting to know how the votes of the various members of the Board of Control stood on this important decision. If those who voted for it were attracted by the very scholarly

manner in which the writer of the prize essay handled the subject, doubtless they were quite right in assigning the award to him, for the subject certainly was handled in a scholarly manner. If, however, mere verbiage and a skilful use of language is to govern these awards, why not submit the essays to the Department of English or to a board of college professors for decision?

It might as well be conceded that the Navy will not have selection, and Congress stands in about the same position; the former for fear that somebody will be "hurt" or someone's "vested rights" will be taken from them; the latter, with more justice, fearing that they may be annoyed by the importunities of naval officers clamoring for advancement.

The whole subject of selection might be summed up in one question. For what does the Navy exist? If for the officer, then we have the most perfect system of selection that could be devised. If, on the contrary, it exists for the country, the question might well be asked if some scheme could not be found whereby the country did not have to accept the "run of the mine."

The paper submitted by Lieut.-Commander Niblack touches upon the most important question now before the Service. The only other question that compares with it in importance is that of gunnery, and this problem has been, I think it is fair to say, practically solved, that is, the rapidity and accuracy of fire of our ships is good. Admitting this, it leaves the skilful handling of our fleets—naval tactics—as the most important subject we have to consider. The question as to whether one agrees with Lieut.-Commander Niblack in his views regarding fleet tactics; regarding his method of attack or the unit or disposition of the fleet; whether speed is a desirable quality when obtained at the sacrifice of armor or gun power, has no bearing on the subject. Personally, I disagree with him on many of these points—but no one can read his paper without being impressed with the fact that he has presented a very valuable paper to the Navy, on a most vital subject.

I think he is in error in his views regarding the value of speed, when you take into consideration what is sacrificed to gain that speed. I am strongly of the opinion that the Battle of the Sea of Japan was not won by superior speed but by superior tactics and gun-fire. It is not made entirely clear, from the published accounts, that the head of the Russian column was enveloped, "capped," by the Japanese fleet. The reports on this point are most conflicting. One of the most satisfactory reports, to my mind, is that written by a distinguished English Admiral, in one of the magazines for January last, in which he shows clearly, if his data is correct, that speed had little to do with it. The Russian fleet was hopelessly defeated from the very instant they turned the heads of their two columns to the eastward to avoid being capped by the Japanese fleet.

However, I do not intend to enter into any extended discussion of the merits or demerits of Lieut-Commander Niblack's essay, but simply wish to extend my thanks to him for having written so valuable an article on so vital a subject to the Service, and at the same time to express my sur-

prise that the Board of Control should have given it second place when compared to an essay on a worn-out subject, whose sole merit consisted in being handled in a scholarly manner.

Commander W. R. RUSH, U. S. Navy.—Perusal of this essay is disappointing, for two reasons: first, and mainly, because there is nothing new in it; and second, because some of the statements therein are not in agreement with fact.

The essay deals with the subject of Battle Tactics of the Squadron from the point of view of about a decade ago; and it is indeed disappointing to find that, an essay which received first honorable mention from so high an authority as the United States Naval Institute is little more than a labored discussion of formations and maneuvers; geometrical solutions of evolutions upon which student naval opinion is already tolerably well agreed. Up-to-date theorists and students of naval battle tactics, who for years have *worked together in conference*, at a place and at times devoted to this one study, have helped in a great degree to crystallize naval expert opinion on Battle Tactics of the Squadron. An humble follower and pupil of these great lights, I hope to be cleared of the charge of immodesty if I say the lights of instruction in this essay burn dimly indeed; they are not head lights, because:

(a) All the "axioms" are embraced, in substance, in already well-known and well-established principles of tactical game-board play with squadrons.

(b) It is well agreed that rectangular movements are the only ones to be considered in squadron battle tactics. There is a very decided value to them, due mainly to simplicity of movement and freedom from speed changes.

(c) No changes in speed are for a moment to be considered in connection with squadron battle tactics. One speed only is admissible, and that is *battle speed*, which is the highest possible sustained speed of the squadron, with a reserve allowance of two knots.

(d) One helm only is admissible in battle tactics—*standard helm*. *Standard helm* is the helm angle which gives the tactical circle of the unhandiest ship of the squadron, *i. e.*, the one having the largest tactical diameter.

(e) There is no comparative value between any of the "Special Methods"; they are all alike, complex and confusing, and involve variations in speed and in helm angle which cannot be tolerated. On the tactical game board they never confuse an opponent; on the contrary, they are anticipated and met by simple maneuvers; they all go down before rectangular movements at constant high speed. The fireworks special methods of the essay are not the best known special methods by any means, and are believed to be impossible of execution, with confidence and certainty, in peace time exercises, in fine bright weather and smooth sea.

(f) Line of bearing tactics are dead and gone. There are others, however, on record which are more successful and are hard to beat—on

paper. *Water work* is what is wanted now, if we are to make any solid advance in tactical study; *i. e.*, squadron vs. squadron on the open sea.

(g) The "Lock" is "The Cap" *pianissimo.*

Success on the game board, as every one knows, is due to superior skill in taking *position*, and by *position* is meant the "superior position" of the essay. But on the water, in action between hostile squadrons, success depends upon (1) superior skill in rapid hitting, and (2) superior skill in taking position. I believe the first of these would win alone even when *position* is bad, but in combination with good position, (1) is certainly invincible. We are striding along toward success in rapid hitting, but are we doing anything towards *position getting* and *position keeping?* I think not much. We must learn *to turn a corner in column at 300 yards at battle speed.* We must learn to *turn together, any number of points, with the same turning circle at battle speed;* afterwards we must study and practice doing these things at exactly the proper time in order to get *position*, or to hold it if threatened with its loss. This can only be done on the water and by squadron against squadron. We are at the end of our paper work.

It appears to some that naval tactics in its true sense includes:

(1) Study of the positions necessary to assume with relation to the enemy in order to obtain an advantage over him; this embraces (a) position to best develop gun-fire, (b) position to best develop torpedo-fire with the least chance of damage from the enemy. In this study, the effect of existing weather conditions must be considered, such as sunlight, wind, and sea. (Game Board Studies.)

(2) Study of the best ways to get into these positions, and to keep in them. (*Game-board play and squadron maneuvers on the water.*)

(3) Study of the best evolutions of the individual ships of the squadron necessary to execute with simplicity, certainty, and celerity the maneuvers of the squadron. (*Standard helm and battle speed on the water.*)

(4) Study of the best ways of communicating the wishes of the commander-in-chief to the individual ships for the performances of these evolutions and maneuvers. (*System of signals.*)

(5) Formulation of the selected position movements into a clear, comprehensive set of "Fighting Instructions"; assigning to each maneuver and evolution a signal number. (Fighting Instructions.)

From this it would seem that the essayist has begun at the right place in his attempt to point out some of (1) and (2) above, but it must be evident that work of this kind is best done *in conference on the game board.* And much work of this kind has been done, and the records of such work bring the study of naval tactics with us down to a point where with these records and conclusions therefrom in hand, further study must be done with the squadron at sea.

Captain E. B. BARRY, U. S. Navy.—Lieutenant-Commander Niblack is to be congratulated for his essay on the Elements of Fleet Tactics. Particularly is that part of the essay worthy of study which bears upon formation in relation to gun-fire. In the final analysis of any war operation

either on land or on water, all other things being equal, success has been gained through (1) advantage of position, (2) making use of such advantage. On the land these resolve themselves into the proper maneuvering of an army before and during a battle, and striking the final blow with a greater force than can be brought to oppose it. On the sea the proper maneuvering of the fleet puts it in the position of advantage and that position when battle is joined is simply a position from which the fleet can concentrate greater volume of fire on a part or the whole of the enemy's fleet than possibly can be returned. This Lieutenant-Commander Niblack shows and his axioms prove it.

When we come to tactical methods and formations I must beg to differ a little.

Drill and preparation in a field with men to represent vessels may be a good beginning but steam-launch drill is better—in fact it is the best fleet-drill preparation that can be devised; it is the ping-pong of the "record" drill and will enable ships later to "keep on the target."

There is only one thing that can be said against steam-launch fleet drill and that is the ease and celerity with which these little boats can be handled. The man that can handle a steam launch to perfection may be helpless when he tries the battleship. Steam launches can be exercised in fleet formation within a few feet of one another but this cannot be done with battleships. Lieutenant-Commander Niblack assumes nine ships at 250 yards interval. The *Maine* and *Missouri* are 388 feet long; putting them in column at 250 yards between centers would leave 121 yards from the bow of one to the stern of the other; the distance between a *Kentucky* and a *Kearsarge*, each 368 feet long, would be 128 yards; between a *Connecticut* and a *Louisiana*, each 450 feet long, this distance would be 100 yards. At these distances battleships cannot maneuver in safety and it would be impossible for a leader to go from line into column by the rectilinear method without collision; I doubt if a column of battleships at this distance could change course in succession more than four points without collision, while at half these relative distances steam launches would be perfectly safe and at all times under control. A battleship is under control only *beyond* a certain distance, be it a straight line or be it a curve; inside the distance required she is powerless to avoid a danger. This, of course, is true of steam launches, but with the latter the distances are so small as almost to be negligible.

It is well known that vessels with headway under the action of the rudder do not turn on the arcs of circles nor do they pivot at the center, but the stern is thrown a considerable distance outside the curve. If vessels turned on arcs of circles with their centers tangent to the curve the interval could be reduced still more, but this never is the case during the first 360° turn. When the distance between the stern of a ship in column and the bow of her next astern is so small that the leader's stern overlaps the bow of her follower owing to the action of the helm at the time the follower should put his helm over, collision will occur and manifestly it must occur if the follower holds his course. Intervals then must be such that a ship endeavoring to change course in the trace of the ship

next ahead can do so without risk of collision, and this cannot be done unless her leader's stern is clear of her bow on the side toward which the change of direction is taking place. Of course a ship can turn inside or outside the turning circle of her next ahead, with the proviso in the former case that the circles do not cross. I think sufficient attention has not been paid to these facts as they are of great importance and may involve the safety of one or more costly battleships.

The overlapping or dangerous situation can be brought about only in four ways: 1st, when the interval is too small; 2d, when the leader in turning, let us say eight points, left, uses some port helm first and then takes standard starboard helm; 3d, when the follower does the same; 4th, when the follower is not in position. It will be seen that fault attaches to three of these conditions, which of course may be corrected, but the first situation renders large changes of course and certain fleet maneuvers impossible.

I think the essayist has mistaken the method of going from line into column as illustrated by his figure 9. The flank or guide ship *C* does not slow but maintains course and standard speed while all the other ships slow to half speed taking up standard speed in succession as they are about entering the column. If this maneuver were to be executed as explained by the essayist there would be general collision.

Turning to figure 10, going from line to column by the "special method," there is another way of doing it that might be as efficacious and certainly much safer. Let the right (or left) division form column by the oblique method and the left (or right) division execute ships right (or left) and take full speed turning into column and slowing at the proper time.

At a speed of 12 knots and 400 yards intervals eight ships will be in column in about 7 minutes 10 seconds. By the oblique method the leader must advance 18 intervals and 17 minutes 42 seconds will be required for No. 8 to reach the column showing a saving of about 4000 yards of distance and 10 minutes of time by the other method.

To go from column into echelon the so-called pin-wheel method is not for battleships. All movements forming on the center should be called central formations. A perfectly feasible method of forming echelon, central formation, is for the leader to change course to the line of bearing (presumably four points) and to be followed in succession by the first division. The rear division obliques in the opposite direction taking up full speed and slowing to standard successively when in position. When the rear ship of the first division has nearly attained position from the central ship that division execute ships half left. There is no slowing and no danger.

Referring to the tactical problems I can see no necessity for *A* to slow forming echelon as illustrated in figure 26. *A* should maintain standard speed and the other ships take up full speed until in position.

There is no question, however, but that the rectangular method as shown in figure 28 is the better, ***unless the Admiral does not wish to shorten the range.***

Breaking the lock can be more quickly executed by a central formation

than by any other method and the return to equality of fire is soonest attained. In figure 31 the *D* fleet will be parallel to the *A* fleet by a central formation when *D* is at *E*.

With the rest of the essay I can have no quarrel and the remarks on signals furnish food for thought.

It always has been a mystery to me why any attempt to use single-letter signals has sought alphabetical order and not meaning. For example, *L* never meant left or *R* right, but if perchance *X* meant right in some trial code *Y* always meant left, *L* usually appeared as form column and *R* as form echelon or something equally disconnected. Every aid that does away with mental effort in signals is a step in the right direction.

Captain RICHARD WAINWRIGHT, U. S. Navy.—Lieutenant-Commander Niblack's essay on Fleet Tactics will prove most valuable if it provokes discussion on that much neglected subject.

I am sorry to differ with him on some of his points. In his discussion of areas of maximum concentrated gun-fire he has exaggerated its importance. The distance of the area from the line of bearing is so short that at ordinary ranges the enemy, if not too far ahead or astern will be wholly within the area. The study of the gun-fire diagrams tends to the heresy of changing the direction of the line of bearing by direct methods or, what is practically worse, "special methods."

When performing tactical evolutions with many assistants on the bridge and the turret guns secured the direct methods can be executed with precision after a little practice. I believe the "special methods" would require much practice under varying conditions of weather, etc., before they could be executed with sufficient precision; and I am very confident that neither direct or "special methods" could be relied upon under battle conditions when the constant moving of the turret guns would render the compass unreliable and when the captain cannot give his undivided attention to the evolution.

A position might be found where the compass would not be seriously affected by the guns but it would be in a very exposed position and far from the steering wheel. It should be possible to execute battle evolutions from the turret without numerous assistants and with only relative bearings.

There is a serious error in the description of figure 9. The flank or guide ship *C* must continue at full speed and the other vessels slow down. While the diagonal is longer than the side, the space to be covered by the guide is double the side. As the guide in this case has to travel twice the distance that is travelled in the rectangular method, it takes about twice as long to execute the evolution.

In figure 24 the essayist says, "As a matter of fact *ABC* has the *superior position*, but is in a wrong *formation*." This is misleading, as the formation, column, would be correct provided the distance from *D* was enough to permit the broadsides of the rear ships concentrating on *D*. The direction of the column *ABC* (figure 25) and not the heading of the ships, gives the advantage. The heading may facilitate concentration or

change of position. This question includes the most important points of battle tactics as at present developed. Consider the center of *ABC* attached to *D* so as to move about it at a uniform distance. When *ABC* is at right angles to *DEF*, *ABC* is in the best position and holds the *T*. Revolved in either direction until the two columns are parallel, the smaller the angle, the less the advantage of position, and when parallel the positions are equal. Therefore the usual answer of the column, in such an inferior position, is to endeavor to parallel the line of bearing of the column in the superior position. This leads to concentric circles.

I have not attempted to point out all the errors that I believe to exist in this paper and only allude to those that seem to me to be the most glaring; but above all, I do not believe in trying battle tactics with steam launches or pulling boats, unless for the education of officers who are not attached to a battle fleet; and then they should only use evolutions that had been tried out in the fleet. Tactics may be studied with the aid of the game board and possibly with launches, but solid conclusions cannot be reached except with the fleet.

Rear Admiral C. F. GOODRICH, U. S. Navy.—It was but a few days since I made appeal to my colleagues who are interested in, or who entertain novel ideas concerning, the handling of the fleet in action (the subject of this admirable essay) for their counsels and suggestions, as I had made up my mind that the necessity was urgent for a painstaking study of this, the most important naval problem still confronting us and demanding at least a tentative solution. And now comes this paper to blaze the way.

I do not understand the writer as claiming finality. Such a result would have been impossible in the scant space allotted him. It is only fair to judge his work by his own standard. His "aim has been merely to clear away some of the misconceptions which seemed to shroud the subject of naval tactics and to offer for study consideration the basic elements of fleet tactics." I think we may all congratulate ourselves that he has begun a task which, I am sure, is not to terminate until we know more of what ships are to do in action, why they will do so, and what influence upon their movements will be exercised by a great number of things, such as practicable speed, turning circles, battery and armor distribution, fire control, torpedoes in battleships, torpedo craft available, signals, range finding, internal communications, external conditions (such as wind, sea, and sunlight), proximity to land, etc, etc. I am reminded, as I write, of the instrument for calculating the tides wherein each correction, however minute or irregular, has its weight in the ultimate figure,—and I wish some ingenious fellow would invent its analogue by which an admiral could at any instant read a tape and learn what should be his next order. Unhappily, fleet actions are not to be directed in such a mechanical fashion, so that, in the long run, the best commander-in-chief will be he who combines the three indispensables,—a thorough knowledge of the theory of the topic, based on extended and faithful study, a wide experience in squadron command and maneuvers, and—a rare combination of mental attributes, a cool head and a fearless pluck predominating.

In the way of investigation, Lieutenant-Commander Niblack has certainly evolved a sound method. It is only graphically that any notion can be conveyed of the relative positions of opposing forces and of their respective advantages and disadvantages. If we had more modern engagements, real and simulated, to analyze by means of a drawing board and cross section paper we might tread our path with better assurance that we were going straight. The paucity of experience must, inevitably, introduce a large factor of doubt—still, if there by any other method of solving this equation, wherein pretty much all the quantities are either unknown or imaginary, I confess that I do not know it. How many ifs and ands and peradventures skip gaily into our statements! Take Mr. Niblack's axiom,—No. 1, for example. There can be no shadow of doubt that it states correctly a desideratum, but—suppose two opposing fleets so placed that concentration on any one ship meant the sacrifice by some vessels of a target close at hand for one quite remote—what then? If tactics were simple we should all be great tacticians. And yet, I accept these axioms frankly and completely, knowing them to be true as abstract propositions and likely to be true in the vast majority of concrete cases. We can deal with the exceptions, if, through much labor, we have mastered the underlying principles. Only, we must not be led into the error of totally neglecting the exceptions.

I should write his axiom 11 without the word "greatest" before value, thus—"Superior speed is tactically of value in enabling a fleet to quickly assume a superior position." It seems to me that the matter of speed in battleships has not been worked out very completely. Speed, combined with equal or greater powers of offense should spell victory. To obtain speed at the loss of either of these powers does not appear to me prudent. I have a great confidence in hitting and staying capacity. Faulty tactics on the part of Rojestvensky may have had its share in his defeat, as well as his lower speed. I grant the advantage of this superiority if not unduly purchased while I regret that it has not as yet, been evaluated. Until then, I shall prefer the better guns and the thicker armor.

As to movements, I agree with the writer that the best way of getting there should be adopted in all cases, even if we have to learn how. As to battle signals, I am ready to drop symmetry of code, etc, for absolute simplicity. The maneuvers and orders need be few in number, requiring but one flag or one letter displayed and as brief an audible signal as can be devised.

Personally I feel deeply gratified for this excellent and suggestive contribution to our naval literature. That the service will greatly gain through it I have no possible doubt. I hope more members of the Naval Institute will be prompted to join Mr. Niblack in his search for the right way of handling our fleets and that he may do as much for this as Sims has done for our target practice. When this is achieved, our fleet, whether large or small, will be a thing not to be neglected in the world's affairs and we, as naval officers, stealing their glory, will be able to say that we have developed its efficiency to a point beyond which no further progress is possible.

Captain J. B. MURDOCK, U. S. Navy.—Mr. Niblack's article is important and timely. The interest in tactical questions is growing in the service and such contributions as this are most welcome.

We often hear the old truism reiterated that the basis of tactics is concentration. Mr. Niblack might have added this as one of his axioms without contributing greatly to tactical science, but he has shown a wise discrimination and by modifying the old theorem and advancing the "concentration of gun fire" in axiom 2, has established a sound basis for further study. Mass concentration of vessels which corresponds to the old idea of concentration in the sail period is now neither advisable or practicable. It is inadvisable because it would inevitably lead to a general melée, in which chance becomes a larger factor than skill, and it is impracticable because the high speed of modern ships and their perfect mobility render it easy to reinforce any part of the line against which a mass concentration of ships might be attempted by an enemy. It is questionable whether such reinforcement would take place, however, as if an enemy wishes to mass his ships he should be encouraged, as he thus masks his own gun fire and affords a vastly better target for both gun and torpedo attack.

The true application of the principle of concentration to-day is not in overwhelming an enemy by the physical effect of mass, but by overcoming his opposition by a weight of well-aimed gun fire, which will demolish his defence. If the speed of both fleets is equal he cannot escape from this concentration and must inevitably lose the day unless he can deliver an equally well-aimed gun fire in return. It is admitted that every naval battle must begin with the gun fire stage, but if one fleet has its ships thoroughly trained to accuracy of gun fire, and its commander can concentrate this fire as he wishes, there will be no other stage unless his opponent is equally well trained The probability is very great, as Mr. Niblack points out, that one of the combatants will lose the battle in the first few minutes.

We have been devoting much time, money, and energy of late to the development of the gun efficiency of single ships, and are therefore in a position to make the next step, the development of fleet gun fire. This must be largely a tactical question, and the responsibility rests entirely on the fleet commander He may by false maneuvering neutralize the gunnery skill of individual ships, which has been so laboriously built up, or on the contrary he may by a wise disposition of his force, enable each ship to utilize its skill to the utmost. It is the same question so well defined in the reply of one of the crew of the *Constitution* to an address made by the captain before one of the engagements of the War of 1812, "You lookout for the quarterdeck and we will take care of the guns."

There is always a tendency to rely on some trick in tactics, which will result in gaining an advantage, and very many such have been proposed. It is not at all impossible that some unexpected movement might demoralize an unskilful adversary, but this system makes a bad basis for the development of tactics. To my mind the true solution is to be found in a principle which fits in as a corollary to Mr. Niblack's axioms 1 and 2. Briefly stated it is: *A fleet commander in battle, should whenever the enemy is*

within range so handle his ships as to keep their guns bearing. In short he should try to reproduce target practice conditions as closely as possible, and should avoid as far as possible any movements which suddenly change either the bearing or distance of the enemy. If he has developed the gunnery skill of his crews it owes it to them and to the country to offer the best possible chance he can for this skill to act.

If this view is correct, our tactical movements should become fitted for battle. We might well study battle tactics pure and simple and bar from the tactical signal books all movements which could not or ought not be attempted under fire. It would be easy to improvise a drill simulating battle, in which a squadron commander could test his skill in keeping the guns of all his ships constantly bearing on a ship supposed to represent the head of an enemy's column, which is allowed full freedom of movement. I am satisfied that a few drills of this kind would support the view taken by Mr. Niblack, that direct movements are bad. No squadron commander would ever repeat a direct movement in battle, as he would have sufficient experience in his first attempt to last his lifetime. Officers believing in these movements have generally been thoroughly disenchanted in trying them in the tactical game. I fully agree with Mr. Niblack's criticism of direct movements, and would go so far as to banish them from the signal work, as unsafe in war and consequently unfit in peace.

Personally I can see no better method of testing tactical movements than by their fitness for battle, and conversely I believe that movements meeting the requirements of battle will suffice for peace. The so-called rectangular movements appear to me to be best fitted for meeting the demands imposed by gunnery conditions in battle and if so are the best. We should cultivate the best and not waste time on inferior tactics.

Mr. Niblack's paper suggests a great number of points in tactics, but it may lead to a better discussion and better advancement if we develop the fundamental ideas first, and nothing will, I believe, be more potent in pricking bubbles and in sifting right ideas from wrong than the one principle, that the aim of battle tactics is to keep the guns of all your ships constantly bearing on the enemy.

Professor PHILIP R. ALGER.—Although the essayist appears not to have meant to do so, yet by his diagrams he conveys the impression that in action the gun-fire of a squadron should be concentrated upon a portion of the enemy's squadron. That such a method of using gun-fire would be fatally defective, might seem too obvious to require discussion. As a matter of fact, however, the method seems to have at some time been endorsed by the War College, as indicated by the following quotation from certain "Notes on Naval Tactics," which I have recently had brought to my attention by an officer who collated them from papers issued by the college: "Concentration of gun-fire is practicable, in any formation by directing half or all the vessels of a fleet to direct all of their fire against one of the enemy's ships. *This one might be disabled by a total fire which would produce but little effect if spread over the whole*

of a fleet. When the ship was evidently disabled as a fighting unit, the gun-fire might be concentrated by signal against some other ship."

Very little consideration is needed to show the fallacy of the italicized part of the foregoing quotation. The greatest possible effect of a squadron's gun-fire can only result from directing the fire of each ship at the enemy nearest to herself.

The fundamental end and aim of naval tactics is to so maneuver as to make one of the enemy's ships *the best target* for several of your own ships; when this has been accomplished, then and then only is it allowable to concentrate your fire.

Promotion by Selection.

(SEE NO. 117.)

Commander ROY C. SMITH, U. S. Navy.—Whether one agrees or disagrees with the conclusions of this paper, all must admit, as was to be expected from the ability of the author, that it presents a great deal of food for thought. The title is apt to mislead. It is not a paper on promotion by selection, but an argument "Against Promotion by Selection." The arrangement is admirable and the arguments are well advanced. The subject is conveniently discussed under four simple heads, as enumerated on page 2. Nearly everyone will concede the justice of the reasoning under the last three heads, which to the author are the principal ones; though one may be permitted to doubt if the first head, which receives but scant attention, is not really the all essential one of the discussion. It is thus formulated, "Selection is desirable in order to obtain and keep younger officers in the grade of commander and above."

The enunciation of this principle is based on the assumption that it is desirable to have younger commanders. If this assumption is not granted, there is no use in arguing about selection or any other method of bringing about a result that is not desirable. Commander Rittenhouse is apparently satisfied with present conditions and does not believe that we need younger commanders, hence we do not need selection to obtain them; and he shows conclusively that we do not need selection for any of the other purposes, hence we do not need it at all. Now the premiss which the essayist denies expresses in the opinion of impartial critics one of the grave faults of the service as it exists to-day, *i. e.*, the age at which officers reach command rank. He does say that, granting the contention, selection is only one way of many of accomplishing the results, and in this the writer agrees with him.

Now to look a little at the question of age. No one will deny that a man in good health, *who has accustomed himself to responsibility at a sufficiently early age,* will continue to perform well all the duties that may be imposed on him to an advanced age. The words italicized are the key to the question, and it is a phase not touched on in the essay. A man placed for the first time in command at the age of fifty is certainly not apt to be enterprising; and barring officers who have held minor

commands, such is now the condition in our service. The same man, having held an independent command in his thirties, will evidently be a different man at fifty. Commander Rittenhouse points to Farragut and our naval commanders in the war with Spain to show that age is no bar. True, with the proviso that they begin to command sufficiently young. Farragut had an independent command when a boy, and our naval chiefs in the war with Spain reached command rank in their thirties.

The senior officers often make the mistake of thinking that their juniors consider them antiquated and wish to replace them. This is by no means true. The proper attitude is for each officer to compare himself with himself at another age. Take the best of our executive officers, now in their forties, and make them captains of battleships. They might make poor captains, which is doubtful; but if they did, they would make worse ones ten years later.

There is another reason for having younger commanders, which the essayist admits, and that is to give them time to learn the duties of a fleet commander before it is time to go on the retired list. When our captains are promoted to be admirals only a year or two before their retirement, they do not have the opportunity. As a matter of fact, it is bad policy to order any captain to the command of a battleship who is not going to have later at least the chance of commanding a fleet of such battleships.

Assuming then the truth of the premiss that it is desirable to have younger commanders, is selection the best method? Selection uncombined with age retirement in the grades might bring some bright men to the front, but it would not improve the average age, which is what is wanted; and this is the chief and dominant argument against promotion by selection. Age retirement in the grades without selection would result in eliminating all the older men of each naval academy class. It is understood that the plan was actually worked out last winter, unofficially, and the appearance of the resulting navy list of a dozen years hence caused the idea to be quietly dropped. Everybody knows that many of the best men in the service were not the youngest men in their classes at the naval academy, even though an investigation some time ago seemed to show that the younger boys entering generally did better than the older ones.

Selection combined with age retirement in the grades is theoretically the best solution, and would be practically the best could any simple method be devised of selecting fairly. The difficulties of finding any such simple method will probably always operate in our service to prevent the adoption of selection. Is there any other method which will produce the desired result, that is younger commanders, and at the same time avoid the objections to selection? Undoubtedly there is, promotion by length of service and selection out. The essayist would evidently favor this view, though he does not develop it, for he says, page 27, "Thus, promotion by seniority with elimination of the unworthy would seem to be the more natural and logical method."

In considering any proposed, workable system, the first essential is that

it shall be absolutely simple. Any application of complicated rules, or reference to fixed numbers in the grades, or fixed annual vacancies for each grade, or resort to actuarial tables, will swamp the system. With this preliminary the following is suggested. Establish a permanent scale of length of service requisite to promotion to each grade and promote when such service has been accomplished. If there result too many incumbents in the higher grade, select out such as can best be spared. Such is the principle, which is simple enough, now as to the details.

We need first some easily applied but perfectly definite sliding scale of numbers in the grades, depending on the size of the navy, just as in the army so many regiments, so many officers. Only in the navy the unit becomes ships instead of regiments, or what is simpler, to allow for different conditions, tons of shipping on the navy list. This idea was fully worked out in an article in the *North American Review* for September, 1902, entitled "The Navy's Greatest Need." It is sufficient here to assume that in the great reservoir of the navy, that is, the officers of the rank of lieutenant and down to and including the midshipmen at the naval academy, there should be so many per ton of shipping on the navy list. When the number falls below this, the Secretary of the Navy should have authority to appeal to the President, Senators and Congressmen, in regular rotation without regard to specified vacancies, to designate the numbers needed to keep the reservoir full, such appointees to enter the naval academy the ensuing session. In the grades above lieutenant, the numbers should bear such a relation to each other as the requirements of the service demand, and the total number should be a certain percentage of the number in the reservoir, that is, should depend on the amount of shipping. These percentages should remain fixed, but the actual numbers should be regulated at the beginning of each fiscal year, July 1, depending on the shipping on the last annual register, and hold for one year.

Next as to promotion. During the course of the fiscal year all vacancies above lieutenant would be filled by seniority, as at present. On the first of July each year, naval academy classes would be promoted, as a class, to the different grades by length of service, that is, such as had not already been promoted previously to fill a vacancy. The following is offered, but the absolute figures are not essential:

Rank.	Minimum age.	Service in grade.	Total service.
Midshipman	15	4	4
Ensign	19	3	7
Junior Lieutenant	22	4	11
Lieutenant	26	6	17
Lieutenant-Commander	32	8	25
Commander	40	7	32
Captain	47	7	39
Rear-Admiral	54		

Thus, 17 years after entry an officer would be promoted lieutenant-commander. During his previous service he would have spent a certain fixed time in each grade, the numbers in the grade being unlimited, as ensigns now do by law; but on his present promotion he enters a grade in which the numbers for that year are limited. If the promotions due to length of service cause the number to be exceeded, a board is convened to select out from the whole grade as many as may be necessary to overcome the excess. The officers so selected out would go on a reserved list for permanent shore duty without future promotion. And so for all the higher grades. A thirty years' optional retirement law is also advocated, which would facilitate the work of the board, as would also voluntary applications for the reserved list, which should be encouraged.

As the navy is now exceptionally short of officers in the lower grades—the reservoir, as it has been called above—any sudden increase in the number required by a normal ratio of numbers to tons of shipping would swamp the naval academy. Hence at the start it would be necessary to limit these large increases to say 20 per cent in any year, which would spread the increase over five years.

It is to be remarked that, in principle, promotion by length of service and selection out differs in no essential from the present actual system. The personnel law requires a certain number of vacancies annually in the grades from captain to lieutenant. These numbers were estimated with the idea of causing a suitable flow of promotion, that is, bringing officers to command rank sufficiently young; and it was to be accomplished by voluntary retirements and selection out. Here we have exactly the same features as in the proposed system, only there is no definite determination of a suitable age for each grade, or what is the same thing, the previous total service; and then an estimation is made of the number of vacancies that will be required to produce this indefinite result. In the proposed system we fix definitely the length of service requisite to promotion, promote when that service has been accomplished, and then eliminate the superfluity, which we then know and do not have to estimate. One method is indirect and devious, and only gives approximate results; the other method is direct and simple and gives at once the very object we seek.

We may assume then that the proposed method will bring men to command rank as early as may be necessary, and in a perfectly simple manner, which is what was set out to be accomplished. There will be three matters to determine at the start, that is, ratio of numbers to tons of shipping, relative percentages in the grades above lieutenant, and length of service requisite to promotion. These matters once settled, the system will work itself. Among its advantages, it will preserve seniority and prevent heart-burnings in the sea-going list; it will prevent sacrificing men who may be above the average age of their classmates; it will offer to the reserved list permanent shore duty as a substitute for future advancement; and on those who are willing to go to sea, as their num-

bers will be relatively limited, it will impose the penalty of comparatively brief shore duty in exchange for a more rapid promotion.

In closing, it may be stated, that in the opinion of the writer a mistake is being made by many persons in advocating reforms because of supposed hardship on the officers in being kept so long without promotion. The hardship on the officers has really nothing to do with the situation. If the conditions are normal, the officers must submit to them. The question is not one for the officers, but for the nation and the people. Under present conditions, are they getting the best worth out of their navy as an investment? In the humble opinion of the writer they assuredly are not, and it is for them to apply the remedy.

Rear-Admiral C. F. GOODRICH, U. S. Navy.—Accepting the Board of Control's invitation to discuss this admirable paper and complying with its injunction not to fill the pages of the Proceedings with reiterations of the essayist's views or mere statements of assent to or dissent from those views, I beg to suggest that, in a late instance of selection in American naval history, well deserved advancement was denied to the ablest man in our service, one who planned and waged a brilliantly successful campaign, and at the same time promotion was generously granted to two fortunate captains, whose unavoidable absence from the action which brought that campaign to a close was not permitted to affect their reward for what every one knows they would have done had they been present.

It may of course be assumed that the advocate of selection approves such measures as are here referred to, incomprehensible as they appear to others.

Captain E. B. BARRY, U. S. Navy.—It is seldom an essay of this character is given to the Navy and it is to be hoped that every one of our selectionists will read it attentively and carefully to the end. Being an anti-selectionist, I suppose I see more in it than will be seen by one of opposite faith, but until one or many of the numerous family of selectionists succeed in refuting the statements and arguments advanced by Commander Rittenhouse in this philosophical document, I shall look upon it as the death knell to selection in the minds of thinking men in our Navy.

Feeling as I do, I am lost in wonder at the calm, judicial manner with which the various points are reviewed, as I generally find it hard to keep my patience when I may be arguing some of these points myself.

The age question got its quietus outside the Navy when the commotion subsided after Dr. Osler's famous statement. The thing was partly refuted and partly laughed away. One comic article represented "our special" at the gates of hell holding an interview with a man sixty years of age dressed as district telegraph messenger. At twenty he had been a bank president and with increasing years had been deprived little by little of trust and responsibility. Would not it be well for our Annapolis graduates to be made rear-admirals upon graduation and

grade their service so that at sixty they could make the famous "two years at sea prior (?) to graduation?"

It has been the fashion, at least in the newspapers, to lay great stress on the physical strain thrown upon the captain of a modern man-of-war. This is not true, he is under less physical strain than is the youngest messenger in the crew. That he is under mental strain I grant, but what of it. Has not his whole career been intended to fit him to bear it? I think another myth has been exploded.

On the subject of rewards the essayist is equally happy. It is a new answer to an old question. If "A" distinguished himself while in the grade of ensign simply by an act of bravery, does not it follow that he is a competent admiral? It would seem that an act of heroism of one kind never yet has been separated from the ability to do something else. I think Commander Rittenhouse touches very logically yet tenderly upon this subject. With the Spanish-American War still fresh in our minds, it is difficult to see how he could have handled the subject any better. Even now occasionally a half suppressed sob of Spanish war hysteria can be detected here and there. One thing the war did, for which we should be thankful, it enriched our language by the addition of the word "hero."

Were the subject of money reward for good service done to be discussed and debated, the phrase "un-American," which we have heard *ad nauseam*, and which I doubt any of its users can define, would be much in evidence; yet these same people have no hesitation in depriving of his rank the officer who happens to be doing his duty on the coast of Africa, and giving his rank to some luckier (*not* more fortunate) officer who perhaps is finishing out a detail made in a time of peace and considered undesirable when no thought of future war disturbed the equanimity of the Navy Department.

The following appeals most eloquently to the student of history. "Does he (the officer) want reward? Does he fear that his name may not survive in the hearts of his countrymen? Indeed it may not. Republics are proverbially ungrateful. Let him then have it carved on a bronze or marble column, ———." These words suggest a fitting epitaph to be cast in enduring bronze and placed over the grave of one of our departed great ones: "Done to death by a grateful (?) country."

Two questions of the essayist that easily can be answered are, why so many commanding generals were "selected" only to be displaced during the first few months of our Civil War and why it took so long to discover our great generals? Influence in one case and the absence of it in the other.

Let us pause for a moment and consider a naval service such as ours subjected to a quarterly, semi-annual, or annual selection for promotion. Let us imagine a dashing lieutenant (why "dashing" I know not except that all lieutenants are supposed to be dashing) the observed of all observers, pronounced by various officers and boards (nothing can be done without a board), fit for promotion to the next higher grade. Hardly is the ink dry on his new commission (issued during the first quarter

of 19—) when a second board selects him, owing to the same transcendent merit and the fourth quarter, half year, or year, finds our hero a rear-admiral. This may seem absurd, but it is well within the possibilities and is indicated in the expressed views of some of our selectionist brethren. Truly would the Navy be hoist with its own fetard.

Of the essayist's objections to selection, while possibly they are all well taken, there is but one of them that to me seems pressing, immediate, corrupting and disentegrating and that is what would be the result of personal and political influence. Efforts are made constantly to gloss this over, to say it is all newspaper talk, to fulminate against it, etc., but it will not down. All efforts to the contrary notwithstanding there is no powerful civilian dealing with the Navy not subject to its control or swayed more or less by its use.

For the purposes of such influences the officers of the navy are divided into three classes: First, officers without influence; second, officers with just enough influence to be ignored at times with safety; third, officers whose influence is so great that it cannot be ignored at any time with safety. When an officer of Class I tries for certain duty he gets it if his request is reasonable and if Classes II and III are not trying for it. Usually he is a man of ability and later may make for himself a professsional backing which may help him; he may approach Class II but always is excluded from Class III. Where ability only is concerned he will be preferred over Class II, but if he strives for a coveted detail he will never get it.

Class II is ignored only when it becomes necessary to answer the following momentous question: How much influence can "A" bring to bear? Is it going to be sufficient to make it dangerous to refuse him the detail? Class II is the one that is accused constantly of using influence, but no one dares accuse Class III. Lest this may be regarded as fiction let me cite two instances: (1) Some years ago a certain officer (Class III) had occupied an exceedingly "soft" position for a long time in spite of every effort of the naval authorities to send him to sea. His principal backer went North and got out of touch, so to speak. Our friend "X" was ordered, by telegraph, to proceed immediately to a certain vessel south of where he was on duty. Calmly packing a small hand-bag and assuring the previously rejoicing officers of his immediate return he took a northerly train and returned in less than 48 hours, much to their disgust, to his original duty with a telegraphic revocation of his last order in his possession!

(2) "Y" was on duty aboard of one ship and desired to go to another on another station giving as a reason that he was entitled to go there. All legitimate efforts for change of orders proved vain as his services really were needed and the authorities failed to appreciate the cogency of his reasoning. As a final effort, several prominent people known to the newspapers as "statesmen" were enlisted in the cause and "Y's" wishes were complied with. "Y" was also in Class III. Neither of these men ever was censured.

A Class I man always weighs the effect produced on others by a change

of his detail. A Class II man frequently does, but a Class III man, secure in his pride of place ignores everything regardless of the injustice frequently brought about except the gratification of his own wishes. If this goes on, as it has been going on for many years, fortunately doing the least amount of harm possible through such corrupting influences, what will be the situation if the field is broadened to include promotion by selection? For one man selected for naval merit there will be two or more selected, or possibly forced, into promotion through influence, and we will be edified prior to each "round up" by the dignified spectacle of a struggle and scramble by the "home contingent" for the selected (?) places. Truly is selection ill adapted to republics.

Speaking generally, the naval officer has nothing to look forward to except the detail and the duty to which his rank entitle him. When that detail or duty is given to his junior of another grade who is not entitled to it, apart from the public announcement thus made that the grade assignment is incorrect, is the cheapening of rank, a serious thing in any naval service—and an indication also that the duty of a certain grade can be performed just as well by the grade below. Here may be noted one of the strongest points in favor of "selection out." When an officer cannot perform the duty of his grade he should be retired and the next man should be given the duty. It is no argument to say that because a certain admiral is incompetent his duty should be performed by an ensign. Yet this is selection logic. If it were possible to pass a bill, general assignment to duty for each grade should be defined by law, with a proviso that no officer of a junior grade could be assigned to any of that duty.

I would recommend to our selectionists a careful study of the essayist's conclusion; by him, motive has not been touched upon, it is possible, even thinkable to believe there may be selectionists that do not expect to be selected; to them I call attention to this important and truthful utterance. "The naval service asks only that to which every individual is entitled, whatever his profession or occupation, common justice and a square deal."

If we "antis" are granted this by our selectionist brethren, selection in future will be but fiction of the brain and no one will have contributed more powerfully to produce that result than Commander Rittenhouse.

Gleanings from the Sea of Japan.

(SEE No. 117.)

Commander Z. L. TANNER, Retired.—This admirable essay upon the Russo-Japanese War in the East is the result of much careful study, excellent judgment in sifting the multitude of conflicting reports from the field of action, and gleaning from the mass a just and conservative estimate of the events of which he writes. I agree with the conclusions of the essayist to such an extent that there is little left to discuss, hence my brief remarks will be confined largely to bringing out a few of the salient points in a stronger light.

Referring to his statement that: "There were also other factors less generally commented upon though of equal importance to influence the situation," I would add that one of these factors was of vastly more than of "equal importance to influence the situation." I refer to the different types from which the respective governments procure the personnel for their vessels of war.

Russia has no maritime population of sufficient importance to make itself a factor in recruiting for the navy. The men are drafted from the army, few of them having any knowledge of the sea, or adaptability for the service. This method may supply good raw material but it requires long and systematic instruction afloat to make it efficient; and the several actions of the late war demonstrated the fact that they had not attained to any considerable degree of excellence.

The Port Arthur fleet lacked much from being in a thorough condition of preparedness when hostilities broke out: the gun-pointers did not produce the best results, owing largely to the lack of training, although a portion of the shortcoming should be attributed to the fact that the guns were not provided with telescopic sights.

There seems to have been a total lack of torpedo defense, even a picket guard was omitted while they were lying in the open sea exposed to torpedo attack, knowing that war was impending and that the Japanese flotillas were within striking distance. It cannot be claimed that there was lack of time and opportunity to put the fleet on a war footing. Hence we are forced to the conclusion that there existed a laxity in administration of the fleet that invited disaster.

Referring to the fleet of Admiral Rojestvenski, we find that some of his ships were hastily commissioned and sent to sea without having had an opportunity for sufficient target practice to fit them for a place in the line of battle. Other vessels of the fleet had been in commission a sufficient length of time to bring them up to a high state of efficiency, yet the lack of modern sights, upon which the best service of guns is so largely dependent, seemed to cast doubt upon the preparedness of the fleet as a whole. The unfortunate occurrence on Doggerbank was the result of nervous tension induced by lack of sea experience. However the fleet were some 15,000 miles from its new base and prospective scene of action and should have improved its personnel during the long voyage in every respect except possibly the gun-fire, and that also should have been benefitted by their detention off Madagascar. The fact that they had target practice but three times must be attributed to lack of spare ammunition.

The detention of Rojestvenski while waiting the arrival of Admiral Nebogatoffi's squadron resulted in the loss of valuable time, and gave Togo an opportunity to refit his fleet, recruit its personnel, and leisurely prepare to meet him upon his arrival. He was thus handicapped without compensating benefits, for Nebogatoffi's coming added to appreciable strength, either moral or material, on the day of battle. It has been intimated, and not without reason, that it would have been better for Rojestvenski had Nebagatoffi never left Russia.

Admiral Rojestvenski refers to trouble with German colliers, trouble that was doubtless serious and might easily have been worse. The policy of employing alien transports of any description in time of war is bad; it introduces an element of weakness and uncertainty that is bound to be a "thorn in the side" of the Admiral even under favorable conditions, and liable under stress to delay or even thwart his plans of operation.

This handicap would be removed by placing transports under charge of naval personnel, or, that being impracticable, the situation would be greatly improved by detailing an experienced naval officer to each transport, with facilities for making and answering signals; and clothed with authority to direct the movements of the vessel under the Admiral's orders.

In the absence of orders in an emergency, he should have authority to use his best judgment in furthering the Admiral's plans.

The insular position of Japan gives to her a maritime population from which to recruit the personnel of her navy. The Japanese coasts are lined with hardy fishermen and coasting seamen who pass their lives on salt water, accustomed to constant exposure, inured to the hardships incident to service on the turbulent waters surrounding their coasts, and what is of equal importance, they are possessed with the sea habit to such a degree that the transition from their accustomed occupation to the decks of a battleship is not altogether strange to them. Being seamen already, it requires only naval training to make of them efficient men-of-war's men.

Many of Togo's officers were veterans of the Chinese war, and the operation against the Port Arthur fleet afforded war experience that made veterans of them all.

The enlisted personnel of his fleet were also in a less degree veterans of the Chinese war, and upon the outbreak of hostilities with Russia his fleet was thoroughly organized and trained to the utmost limit in times of peace. Operations against the Port Arthur fleet afforded them the great benefit of war service, the prestige of victory, and a self-confidence that made them almost invincible.

His fleet was composed of modern vessels equipped with every known device to increase their efficiency, including telescopic sights, and torpedo defenses. His gun-pointers were perfectly familiar with their weapons.

The essayist comments upon the marked improvement of the gun-pointers between the action of the 10th of August and the 27th of May, which speaks well for the system of instruction, and remarkable display of industry, yet the steadying effect produced by the tonic of battle experience upon the nerves of the gun-pointers seems to me to have been a leading factor of the observed improvement.

The Japanese flotillas of torpedo boats and destroyers were a most useful adjunct to Togo's fleet throughout the war. They were well organized and effective so far as training in time of peace could make them so. The attack of February 8 was their first war experience and

showed dash and zeal, but lacked that calmness born of experience to insure careful attention to details.

Their performance during the final battle showed that they had profited by their experience during the war; they followed the true method of attacking in swarms too numerous to be beaten off, and no safety plugs were found in floating torpedoes after the battle.

I agree with the essayist that Rojestvenski's formation for the passage of the straits was the best he could have made, so far as the fighting line was concerned; but the cruisers and special service vessels were dead-wood, adding nothing to the strength of the battleship columns, and should have been left at the Saddles; or, such of them as had sufficient coal endurance might have been sent east about to Vladivostok. Despatching them for forty-eight hours or more before the departure of the battleships, and by covering the movement with his scouts, it would have been impossible for the Japanese to determine the lines upon which the division had been made with any degree of accuracy until it was too late.

It would at least have divided Togo's attention, and might have affected, in some degree, the final result.

Rojestvenski's double column formation of his battleships leads naturally to the conclusion that it was his intention to fight the battle in single column forming either to the right or left, dependent upon the direction of the attack. While it is true that Vladivostok was his goal, it seems hardly within the limits of possibility that he would submit to having his best ships destroyed in detail rather than deviate from his course. The disastrous effects of the concentrated attack upon the *Oslabia* should have been sufficient warning for the left column to form on the right without orders by signal or otherwise; and it is past understanding why the *Souvaroff* should have held her course to certain destruction having in view the fate of the *Oslabia,* and the certainty that a similar fate awaited her.

Had it been any other than the flag ship the captain would have been censured for lack of initiative in failing to parallel the course of the attacking fleet at once, which would have placed the contending forces upon practically equal terms as to position. Had this course been taken, the first battle, upon relatively equal terms, between modern battleships, might have been saved from what the essayist remarks was a *debacle.*

It will hardly be denied that Rojestvenski ably conducted his fleet, with few mistakes, to the moment of battle. But from that time to the end, Togo was master of the situation, gaining the most remarkable victory of the age through the superior fighting power of the personnel of his fleet.

The value of war experience was illustrated with singular force in this decisive action, and demonstrates beyond question that it must be reckoned with as a principal factor in considering the relative fighting efficiency of opposing forces.

Commander J. H. GLENNON, U. S. Navy.—It seems to me that the question of the calibers of guns to be carried is largely a question of the range at which battles are to be fought, and this in turn depends on the chance of hitting. In narrow waters, and with a distinct objective known to the enemy, which knowledge would enable him to regulate his maneuvers and dispositions, it is quite possible that a fleet might become so bunched by his maneuvers that shots fired at one ship would hit another and that lessons might be drawn from the result that would certainly be fallacious in other cases. To show how different may be the deductions drawn, it is only necessary to consider the various examples we already have. The lesson of the Adriatic Sea, to my mind, is that with both sides using smoke-producing powder, close range and the ram followed. This would of course be considerably modified by floating mines and torpedoes nowadays. The lesson of Santiago is that with one fleet using smokeless and the other smoke-producing powder, the small or medium caliber guns win the battle, and that at a long range the vessels using the smoke-producing powders have a great advantage, and are practically uninjured. The same is true of Manila, even against a land battery. To illustrate the difference between smokeless and smoke-producing powders, it is only necessary to refer to a case witnessed by a number of naval officers about June 22, 1898, when the *Texas* made a feint as if to land a force of the army by running towards a small bight about two miles to the westward of the entrance to Santiago. For once one of two 6-inch guns mounted in the Socapa Battery opened fire on her without having been fired at, one shot falling short, another long, and the third hitting her. The *Texas* fired two shots, the second fired simultaneously with the third from the battery, dismounted this gun, and no further shots were fired from the other gun. A few men were injured or killed on the *Texas* by the shot which hit her, but because of the cloud of smoke from her own guns, nobody on shore knew that she had been hit, nor did any one in the fleet suspect it except from the obstinacy with which she continued to fire at the battery for long afterwards. Those who have watched a ship firing all her rapid-fire guns, using smoke-producing powder, under battle conditions, know well from personal observation that in calm weather (and I am thinking particularly of a target practice under such conditions that the *Raleigh* had in 1897 or early in 1898, off Cape Charles), she is completely enveloped in smoke and invisible to the tops of her masts, only a large cloud moving along, the trucks of a mast occasionally becoming visible. What is the possibility of range finding in such a case with present devices, especially if the topmasts be sent down? A question is pertinent in this connection, namely,—does the target in such a case become visible more quickly from the vessel than the vessel from the target,—owing to some trick of refraction or reflection, the smoke envelope acting as would the walls of a room?

The lesson drawn from the battle of the Sea of Japan is said to be a lesson of large guns. If so, it is a lesson of range finding, and in all probability the Russians could have forced close quarters and small guns by using smoke-producing powders. Right here it may be said

that there is no telescopic sight that can overcome an inaccuracy in the range. The accuracy of a sight and pointer only renders certain that the enemy will not be hit if the range is given inaccurately at long ranges.

This is not intended to discredit the accurate sight, but to show its limitations. At close range there is no question as to its value, and it should not be lost sight of, that at close ranges, the 6-inch and 7-inch guns, with their continuous aim, are at least as accurate as the heavier calibers, and with armor-piercing shell which will penetrate the armor of the adversary, are sufficiently deadly for purposes of battle. How, where the armor can be pierced, is a 12-inch gun superior to eight 6-inch which weigh about the same. One 6-inch at sea will probably fire as great a weight of ammunition per minute as one 12-inch, and within ranges where it will pierce the armor, which ranges are capable of being brought about (or else the case will be *non prossed* by an adroit adversary who uses smokeless or smoke-producing powders as best suits his purposes), what advantage will there generally be in a case in which a weight of metal is placed in one locality over one in which it is distributed in a number of different places, one of which may effect vital injury. This, it should be understood, is a comparison at close quarters between one 6-inch gun and one 12-inch, a comparison at the last analysis when using several 6-inch guns as against one 12-inch between a heavy current of metal of a low potential and a light current of heavy potential. It should not be lost sight of that one 6-inch shot may disable two 12-inch guns mounted in a turret, and this may be possible without the shell entering the turret at all, but simply by straining some part that is weak, and the weakness possibly unknown. Those who have handled turrets and turret guns know that provision must be made for everything. They are like babies, and the chapter of accidents that have happened to turrets in the American Navy, immediately before and during the Spanish-American War, and I venture to say, to Japanese and Russians, in the sea battles of the Russo-Japanese War, would make very interesting reading if collated. The prominent naval officer mentioned in the essay, quoted as deducing from the battle the opinion that "in the armament of a battleship there should be not only 12-inch, but also 10-inch and 8-inch, with an auxiliary equipment of 6-inch pieces" (see page 84), is, I think, basing his opinion on this knowledge. The fact that 8-inch guns are mentioned afterwards as better is part of a knowledge that so many accidents to such turrets have not happened. The present essayist himself has, I know, the same knowledge of these deficiencies. Since 1898, progress has been made in turrets and their mounts, parts not balanced before being now balanced, doing away with the necessity for such powerful machines to work them. The very weakening of the machines, in case of untoward accident, of which there is likely to be so much as in battle, may prove the undoing of the turrets.

There is another point I think lost sight of in the present tendency towards 12-inch and 3-inch guns, and that is, the value of the medium caliber guns against torpedo-boats. Three-inch guns are probably sufficiently accurate for firing at torpedo-boats up to 3500 yards. Some doubt

has been expressed as to their accuracy at 3000 yards, but, granting them regular in their action at 3500 yards, or 500 yards beyond the latest developed torpedo range, are ships to cease firing at them because they are at 5000 yards, or what gun is to be employed? The 6-inch gun would be fairly regular at all ranges at which any gun would be fired at them, that is, where there was any practical chance of hitting. It would probably be quite as regular, so far as the gun alone is concerned, at 6000 yards, as the 3-inch is at 3000 yards.

Let us consider a hypothetical case where one enemy armed with 6-inch guns picks up in a fog or on a dark night an enemy close aboard, armed only with 12-inch guns and 3-inch guns, which latter cannot, under the most advantageous circumstances, pierce her armor. What might be the result? Possibly a disablement of the latter before he got his 12-inch guns going at all, for these large guns and complex engines of war cannot be kept in the same readiness for battle as the smaller calibers without absolutely wearing out the personnel and otherwise seriously affecting the efficiency of the vessel.

Avoiding theoretical cases and getting down to hard facts, the known certain wear and tear of these large guns alone, regardless of mounts, in battle, imagining that they have been fired 100 rounds each, a thing which might happen, or should be provided for, at the very least must be considered. A navy 6-inch gun has been fired 1500 times and the rifling is practically as good as new. What would be expected of a 12-inch gun that had fired one-eighth of this number?

The lesson to be drawn from the battle off Port Arthur, is, in my opinion, about as follows: When you are otherwise ready, and the enemy is practically blockading you, take plenty of ammunition on board, a double or treble allowance; shorten your coal accordingly; hoist your battle flags; allow him to use his wireless, to come to you and fight him fairly. If you defeat him, as you probably will, if he keeps at long range, owing to the necessary waste of ammunition, which with him must be inferior in quantity to yours (for he like you must have enough coal to return to his fortified base and he is further away), you can compel him to return to a home port by keeping such company as your slower speed and the necessity for recoaling may allow. If you are of superior speed, you can destroy him while still close to your home port. The Russians should not have attempted to escape from Port Arthur. Defeating the Japanse would have opened the port and cut the Japanese navy and army's real line of supply. It would have put heart into the Russians, and they would have been able, with a definite previous plan, to get reinforcements and necessary supplies, and begin the war anew. It might not have been a Waterloo, but it might very well have been a Gettysburg. The Japanese in this battle must have learned a lesson, and in the Battle of Tsu Shima they must have been well loaded with ammunition, probably at the expense of coal, while the Russians, whose minds had been on coal up to that time because of a wrong objective, namely, one which was not the Japanese fleet, expended probably the last ounce of ammunition on board the ships that really did the fighting, and were then handled by the

Japanese with their greater allowance of ammunition, as at close range target practice, lasting probably only a few minutes, when a final *coup de grace* was given by torpedo-boats to an absolutely disabled enemy.

The primary lesson of Tsu Shima is the same as that for Port Arthur, one of ships sallying from their own port against an enemy nearby, and fighting a teasing, long range fight until his ammunition became low. The Japanese, unlike the Russians in the previous case, had provided a reserve stock of ammunition and well knew that the enemy must be suffering from what they must have been suffering while compelled to keep the sea, and use coal in the neighborhood of Port Arthur. They probably kept enough coal on board in this case to steam to Vladivostock fast, and slowly back to some coaling station nearby, and hung on to their base with bunkers so filled to the last minute. After the destruction of the first three or four vessels, this battle became a flight, the Russians trying to escape in various directions, those going northward being dogged determinedly, while those to the southward, and who might be expected later to the northward, were not followed. But the mere gathering of the fruits of victory is not the battle itself, and the subsequent annihilation was simply a result of the previous battle. There is a great deal of difference as regards the feeling of the personnel of a ship when the enemy is approaching and when he is running away. In the former almost anything may be expected to happen, in the latter target practice is going on, which you can stop at any time you choose. The first requires bravery, the second persistency. A reading between the lines as to what followed the battle of Port Arthur, shows a lack of persistency on the part of the Japanese, who had already shown themselves brave, that might have readily been interpreted by a Russian Paul Jones as defeat, and justify a further trial of a few rounds with them for possible results.

Relative to torpedo attack at night, the value of a defense that will keep out a torpedo when the ship is immovable in the water, not one for full or reduced speeds or for any other condition, should not be lost sight of. Such defense should be understood to be for the simple purpose of preventing surprise.

I desire to express my obligation to the essayist for his very interesting and instructive paper and to say that I take no exception to his conclusions so far as the value of the Japanese maneuvers in that battle are concerned. The method of capping or preventing capping is presented in a clear and forcible way that should be taken to heart. The question of numerous small battleships or a few large ones is not, I consider, definitely settled at all. It is a very intricate question solved ordinarily by consideration of the concentration of guns, which affects only the offensive power of the fleet. The smaller defensive power of four ships as against six ships where, as he states in his opening sentence, "the forces of nature are so potent for good or ill," is rarely or never taken acount of, and it should be remembered that the value of a vessel or a combination of vessels is approximately the product of the offensive and defensive powers. Without attempting to solve this riddle I will close by expressing the opinion that the best battleship to build at present is one which can fight the

best at close and fairly close quarters, with sufficient engine power ordinarily to get there, and with obscuring devices either in the form of smoke-producing powders, or smoke-producers of any kind, to prevent an adversary from choosing or using the long range if he desires and is able through his engines so to do.

The following points should be remembered in this connection:

(1) Assuming that a battleship can be built in such a manner that she will have nothing to fear from anything smaller than 12-inch guns, the best ship to build is one having only big guns. A ship with these defensive properties has yet to be designed, and no present design of sea-going ship even approximates to such qualities.

(2) You cannot be accurate if you fire through smoke even if it is thin enough to see through. The same is true of the hot gases from smokeless powder, which are there in equal or greater quantity, and the same error exists unsuspected. Is it the gas or the solid which causes the refraction?

(3) We need fire control (by spotting, by splash) because range finders at the best give only true range; besides, they too are disturbed by refraction, and in any event we want the pointer's range for the gun he is firing under the given conditions, atmospheric and otherwise. A fire control system can be devised that will work for 12-inch and 6-inch guns together.

(4) In clear weather, it will require time to get to close quarters, plenty of time for a 12-inch battleship to destroy one armed with 6-inch guns only. As a consequence, big guns must be installed. It is only the proportion that is in question. Wasted ammuniton at long range can come from 6-inch as well as from 12-inch guns.

(5) With the advent of torpedoes and mines, and the demise, so to speak, of the ram, speed has ceased to be a great determining factor in battle proper. Good maneuvering qualities are still necessary for the protection of your friends from yourself and vice versa; for the ram is still deadly if applied. Is there any lesson to be gathered from this? Speed is still necessary after battle either to avoid annihilation in case of defeat or to gather the fruits of victory.

The Alarming Condition of the Navy Personnel.

(SEE No. 117.)

Commander ROY C. SMITH, U. S. Navy.—This article gives the present writer considerable satisfaction, as it is based on identically the same principles as his own scheme contained in a discussion of Commander Rittenhouse's prize essay of this year (see elsewhere in this number), which discussion was written without any previous knowledge of Lieut-Comdr. Key's article.

The two plans are so nearly alike that a comparison of the differences will not be uninteresting. Both are based on an age in grade or length of service qualification for promotion, with a reserve list for shore duty made up by voluntary applications and selections out from the excess of the sea-going list. A comparison of the ages in grades and corresponding lengths of service in the two schemes is as follows:

Rank.	Lieut.-Comdr. Key. Minimum age.	Service in grade.	Total service.	Present writer. Minimum age.	Service in grade.	Total service.
Midshipman,	15	4	4	15	4	4
Ensign,	19	3	7	19	3	7
Lieutenant, J. G.,	22	3	10	22	4	11
Lieutenant,	25	11	21	26	6	17
Lieut.-Comdr.,	36	7	28	32	8	25
Commander,	43	4	32	40	7	32
Captain,	47	7	39	47	7	39
Rear Admiral, Vice Admiral	54	7-9		54		

The present writer did not take into account vice admirals, but he wishes to commend most heartily the whole of Lieut.-Comdr. Key's argument on that subject. The ages in the two schemes, as shown in the above table, are merely a detail. The final ages would have to be arrived at after full consideration by a careful board. It may be stated that in foreign services, notably the English, the ages are materially lower than in either of the two schemes above.

The other point of difference is this. Lieut.-Comdr. Key fixes his ages, then he computes the average vacancies that will be required in the grades of captain, commander, and lieutenant-commander, in addition to casualties and age retirements, in order to cause the necessary flow of promotion to produce the desired result. Now this method would give correct results when applied to large numbers of men under similar conditions, numbers running into thousands, but when applied to the limited numbers on the navy list, it would only prove correct on the average, or in considering a great many years together. In individual years, from accidental causes, the variations might be so considerable as to deprive the result of all value. Now we know perfectly well what we want. We want to have commanders, and lieutenant-commanders, and lieutenants, and so on, of a certain age, with variations no greater than are to be found in the same naval academy class, that is, we want promotions after a certain length of service. Then why not promote after such length of service, and select out the excess afterwards? This accomplishes directly and without the least complication what the other method accomplishes indirectly and approximately and with considerable complication.

In conclusion, proportion the total list to the tonnage, and make the numbers in the grades percentages of the whole, and promote after a required length of service, with selection out of the excess, and the whole object is accomplished absolutely directly and with no complication whatever.

Purchase System of the Navy.

(SEE No. 117.)

Pay Inspector T. H. HICKS, U. S. Navy.—It is somewhat difficult to comment upon an article with which one is in absolute agreement in its

entirety, and it is in this position that I find myself in regard to "The Purchase System of the Navy."

There is one point, however, which might perhaps be more strongly emphasized—the exaction of penalties by the government for supplies not delivered within the time specified by contracts.

Before the institution of this system, the navy was absolutely at the mercy of unscrupulous contractors in purchasing articles necessitating manufacture by outside parties. Let us suppose, for example, that the government was in need of a certain article which could not be manufactured in less than thirty days. After advertising and issuing proposals, it made a contract for delivery within that time, and so informed the general storekeeper of the yard at which the supplies were to be delivered. In the contract was inserted a clause to the effect that if satisfactory delivery were not made, the government might purchase the supplies from other merchants, charging the increase in cost, if any, to the delinquent contractor. At the expiration of the thirty days, when the government had a right to expect the delivery, the contractor would call upon the general storekeeper, or at the bureau, and, with many protestations of regret, relate a calamitous tale of unforseen acts of God which had prevented his delivering on time; and would request an extension of two weeks, adding an assurance of delivery within that time. That extension was usually granted, the only alternative to the government being a cancellation of contract and the placing of the order with another merchant, thereby necessitating a delay of at least thirty days for manufacture. At the end of the two weeks, another week or ten days would be extracted by the same means, and the government was lucky ordinarily if it obtained delivered within sixty days, double the number in which delivery was originally promised. And its troubles were not usually ended with delivery. A rival bidder frequently appeared, and entered a charge of bad faith against the government, saying in effect, "you stipulated that delivery should be made within thirty days, and I made a bid upon that condition, expecting to work my factory overtime perhaps, to comply with the requirements. Had I known that you would allow sixty days, I could have underbid my rival by a thousand dollars."

The above exemplifies a very common occurrence in former days, and so well was the government's position understood, and taken advantage of, that conditions became well nigh intolerable and the penalty system was devised. A liberal provision for the remission of penalties on account of delays caused by strikes, riots, fires and other disasters, and delays on the part of transportation companies was inserted, and this provision was construed in the most liberal manner; that is, if by any possible conception the delay could be attributed to one of the above causes, penalty was *always* remitted; if it could not be so attributed, *never*. And from this position the Bureau of Supplies and Accounts never budged, no matter how great was the political influence brought to bear.

The result was a healthy understanding between the bureau and its contractors, which resulted in deliveries almost satisfactory. Personally I find it difficult to understand how a penalty could ever be remitted upon

the ground that no damage has been done to the government, since I am of opinion that one of two contracting parties is always damaged when the contract is violated by the other party; and the actual damage to the government due to retardation of its work on account of delayed deliveries, is but a lesser one.

Far more important is the fact that it may be charged with bad faith by a merchant, who proposes to deliver within the specified time at a certain price—high perhaps, because of the short time allowed—and who sees his rival obtain the contract, take double the time for delivery and reap the fruits of a failure to abide by an agreement.

It would appear to be only fair, therefore, to all concerned, for the government to exact the penalty to the uttermost cent, in every case for which remission is not provided in the contract; or else to abandon the penalty system entirely.

Paymaster DAVID POTTER, U. S. Navy.—In Pay Inspector J. A. Mudd's very instructive article in the PROCEEDINGS OF THE NAVAL INSTITUTE, on "The Purchase System of the Navy," the last part of his remarks is headed "Honesty of Purpose," and that section opens with the following sentences: "But with all the laws and amending of laws, with all the reforms and studied organization, nothing will avail unless we have the constant honest endeavor, the patriotic striving of the human element of the purchase and general store systems. Honesty, thoroughness, and constant endeavor will sow the seed of ability in the most barren soil, and in time, promote efficiency." By these words Pay Inspector Mudd rightly broadens his argument from facts to ideals, from the physical to the ethical. It is, then, the ethics of the "human element" working toward efficiency that I purpose to discuss here.

It has somewhere been finely said that all acts are of three kinds: "Some things we do because we must—they are our work; some things we do because we ought—they are our duty; some things we do because we like—they are our pleasure." It is evident that to reach the perfection of endeavor, so far as obtainable, the characteristics of all these three should unite to form one resultant—thus only (as Pay Inspector Mudd aptly puts it) we will "have inside as much or even more than we paint on the outside."

Work, duty, and pleasure, if rightly considered in our special view of it, are the same thing—qualities so interwelded and interdependent that the test of any one of the three is the test of the others, the absence or presence of one of them the absence or presence of them all. Esprit de corps is a proper part of this resultant also; soldierly alertness and appearance; a fixedness of opinion on matters of right conduct, and ability to state ground for that opinion; resolution, unaggressive but active; knowledge—all these it is believed are a part of an ethical equipment to the full as necessary to the pay-officer as to any other.

It is incumbent on a pay-officer to be even more solicitous as to his professional ethics than an officer of any other corps. The men who have to do with the "purchase" of articles meet with temptations utterly un-

known to the men who use those articles "in being." Some of these temptations are woefully gross, some are appallingly subtle, but all are alike insidious—all alike require ethical character to withstand. This is no idle remark—in every harbor from Port Said to Zamboanga, and from New York to Callao, the pay-officer of the smallest gunboat has met and—thank Heaven! with the rarest exceptions overthrown!—the lion in the path. The ethical standard of the pay-officer must be as constant as the stars—must be almost acutely puritanical—if he would emerge unscathed from such encounters.

Yet with such a standard of ethics knowledge must be incorporated or he will be fit only for the cloister, not for the world of men. I refer not only to the understanding that gives power to do a particular thing in the best way; but to that finer knowledge that gives tact in the handling of men, sympathy and comprehension of those about him, tolerance of the views and actions of such as differ from him. Without this form of knowledge all other forms can avail only for reflection, never for effective execution.

Pay Inspector Mudd in his fine figure of a sideshow presents a truth, the applicability of which to the navy, however unpalatable, cannot be altogether denied. Not long since I heard the same truth put more bluntly by a recent graduate of the Naval Academy: "*Before*" (he said) "*before* I entered the service I thought all naval officers were honorable." The conclusion to which he had since come is obvious. It is obvious but lamentable. No group of men can be perfect but—and it may be said with boldness—it is possible for officers of the navy to be more nearly so than any other group of men who work for a living. Naval officers work for the Government; they work, therefore, without the hideous stress of industrial competition; without the false incitement of material advantage; without undue anxiety for their present or future livelihood—they can follow the path of work, duty, and pleasure, in all honor, to the desired resultant—efficiency.

Is Amalgamation a Failure?

(SEE No. 116.)

Lieut.-Commander G. KAENIMERLING, U. S. Navy.—There is probably no profession in which there is more conservatism than that of the sailor as we have known him in the past, this even to the extent of being hide bound.

In the original article this is touched upon in reference to older officers not being in accord with the present law. When speaking of older officers this should include officers of all branches.

It is easy to recall the time when some of the old school would not accept gracefully the fact that coal was dirty and that it was necessary to have a dirty ship when coaling. That wonderful progress has been made in the right direction is evident when coaling ship has come to be one of the principal drills in which everyone on board ship participates, and has obtained such prominence that a healthy rivalry to excel in this respect has sprung up between ships, as also a rivalry between various sections on board ship.

The writer of this, being not one of the older officers, at least as regards rank, and having been one of the reformees during all the radical evolution periods of the service, beginning with the act of August 5, 1882, as a member of the class of '81, exactly on the dividing line of what was and what was to be, feels justified in giving his views, as he certainly has had evolution experience.

He has, so to speak, been repeatedly operated upon. As one receives positive and lasting impressions during times of upheaval, as in war if actively engaged, so the experience in the midst of these service upheavals must leave a strong impression, if one is devoted to his work, has an interest in the service, and is ambitious.

The article under discussion may be generally divided into the following leading captions:

1st. The necessity for the present law.

2d. That the law if carried out will provide what is needed, the course of engineering instructions being better now than it has ever been.

3d. That the line officer must be a good all-around officer, but there should be a limited number detailed to specialize not only in marine engineering, but also in ordnance and electricity.

With reference to the first caption, I am not in exact accord with the reason given for the existence of the law.

Though agreeing on the second caption, it is believed that too much reliance is generally placed on the schooling at the Naval Academy in itself making an officer.

It would seem that no argument can be advanced against the scheme of the third caption, referring to specializing, unless it is the details of accomplishing this.

Engineering should be the foundation of a naval officer's training of to-day, as it is now in our service. The law was a natural sequence, and forced itself on the service because it was a development of the times. It was not so much foresight which planned the law, as it was a necessity because engineering asserted itself.

If the law had been accepted in good faith at the beginning, much better results would have been attained by this time, notwithstanding the dearth of officers, which was of course a very great impediment. Many of the officers, especially those of higher rank, did not consider the law a true solution of the real demands of the service.

Many commanders of ships, being well versed in their profession but having had no engineering training, were not inclined to give the engineering the consideration it should have on board ship. With the rising of the younger officers to the higher rank all this will be corrected, and it is believed much better results will be obtained.

Although the engineering course at the Naval Academy is an excellent one, that in itself does not make the graduates engineers, nor does the course necessarily make efficient line officers.

Because a man takes a course in medicine he is not necessarily an efficient doctor; though he studies law he may still not be a capable lawyer; nor does the study of painting ensure a good painter. For the same reason

the schooling at the Naval Academy does not necessarily make a good naval officer.

The schooling in all professions, though so necessary, is after all only the foundation, the man's hardest work and what really determines his success being his application after he leaves school.

It is for that reason that unless after leaving school an officer has an opportunity to develop because of the duties assigned him, his schooling counts for little.

For that reason, after graduation, though the officer may not be subjected to a regular course of instruction, a close record should be kept as to his capability, which means primarily his application. The scrutiny, then, which is supposed to be exercised at the Academy should not be relinquished in the lower grades.

Though everyone knows that anybody's place can be filled by someone, it does not follow that it can be filled by anyone, not even if they all have had the same schooling and subsequent training.

On that account the personal factor should have more consideration, and it is believed there is now a decided tendency in that direction.

This is mentioned because since the passage of the personnel bill and until recently this has not been the case.

It is noted that in war times much attention is given to special fitness. Special men are selected for specific duties.

In other words, during peace times the human and personal factor is not given enough consideration, an officer on the round peg and square hole principle being frequently assigned to a duty for which he is not especially fitted, though sometimes to his liking because of personal considerations. In such cases the office and government naturally do not profit much.

It is especially the round peg and square hole procedure more than anything else which makes the promotion by seniority a necessity during peace times.

War, if it lasts long enough, develops the right man, and sometimes he comes to the front from obscurity.

The only difficulty of to-day is that the initial blows in wars count for so much, and that the wars are not likely to be of such long duration as formerly, so that we should not have to wait for the development of the right man.

This makes thorough training all the more necessary, and should require not only a severe course at the Naval Academy, but also a severe supervision of the lower grades when as in civil life a man really establishes his position in his profession, rather than by his school standing.

The suggestion that a limited number of specialties for various branches of the service be selected from the lieutenant grade when coming up for promotion to lieutenant-commander, does not seem to meet the rquirements, in so far that one's promotion to any particular grade is a decidedly variable factor as time goes on.

One's special development should be effected at a certain age, not when one has a specific rank with which, as the law stands, age has nothing to do. For instance, the writer was promoted to the grade of lieutenant-

commander when he was 45 years old, hardly an age for him to await until he should be allowed to select as a specialist.

A much more desirable arrangement would provide for the selection of the specialists at the expiration of a fixed number of years after their leaving the Academy, the number of years to be made as small as possible.

The fact that, under the old law, engineers had a special training, did not make them all designing engineers because of this, as in all professions, the real development of professional qualities depended upon the application of the individual after graduation.

Foreign services, it is believed, not only permit but encourage officers by special consideration in assignment of duties and allowances to develop themselves in specific directions for which they have a leaning or talent. The dearth of officers has prohibited any such consideration on the part of the department, but when officers are capable such ambitions should be encouraged when admissible, as it would accrue to the interest of the service.

The only branch which has this privilege now is the construction corps, where it is done invariably and most extensively, each officer being given a long special course.

As each bureau is responsible for its particular work, it should have something to say about the officers selected as specialists coming under the profession of that particular bureau.

This also, it is believed, is the invariable rule with the construction corps.

In conclusion, the writer believes that, above all other things, we should not have another service upheaval. We have had an illustration from results and the extant discussions of the personnel act, how long it takes after such an upheaval to come to a fairly smooth working condition.

Though slight modifications as above suggested, as to specialists, etc., are desirable, the fundamental purpose of the law should not be changed.

Much can be done at once if the best use is made of the authority given by the present law, and it should not be difficult to obtain legislation allowing a fixed number of specialists in each branch. In the meantime, as the law stands, a disposition to specialize, where there is an evidence of ability in the right direction, should be encouraged.

JOHN PAUL JONES.

The portrait of John Paul Jones which forms the frontispiece of this number is a copy, reduced, of a sepia drawing owned by Mrs. J. V. L. Pruyn, of Albany, N. Y., who has kindly authorized its reproduction in the PROCEEDINGS. Beyond the fact that the drawing is old and came from France, nothing is known of it. It is, however, of considerable artistic merit, is unquestionably a likeness of Jones, and has all the marks of having been drawn from life.

Readers of the PROCEEDINGS may be interested to learn that the colored portrait which forms the frontispiece of Vol. I of Buell's Life of Jones, and the history of which he gives in an appendix quoted on page 595 of No. 115 of the PROCEEDINGS, is quite certainly fraudulent. The Chief Trustee of the Imperial Hermitage informs me that no such miniature as Buell describes exists in the Hermitage collection, and that no trace of such a miniature can be found in the old inventories. Neither is there such a miniature in the (personal) library of the Emperor in the Winter Palace, nor in the collection in the apartments of the late Emperor Alexander II.—EDITOR.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS, AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Erzherzog Karl	10,600	Trieste.	Under trial.
Erzherzog Friedrich	10,600	"	" "
Erzherzog Ferdinand-Max.	10,600	"	Building.

On account of the excessive price asked by foreign shipbuilders, the Austrian government has decided to build in Austria the twenty-three torpedo-boats and eleven destroyers whose plans have been approved. Of these, thirteen torpedo-boats and five destroyers have been begun at Trieste, and now the Danube Society has contracted to build the remaining ten torpedo-boats and six destroyers for a total price of 16,630,000 francs. The torpedo-boats will be of the type *Kaiman*, of 200 tons, and the destroyers of the type *Husgar*, of 400 tons.—*Le Yacht.*

The Austrian cruisers *Kaiser Franz Josef* and *Kaiserin Elisabeth* are having their old 9.4-inch bow and stern guns replaced by modern 6-inch pieces. This is following the Italian lead with some somewhat similar vessels.—*Engineer.*

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships			
République	14,865	Brest.	Launched Sept., 1902.
Démocratie	14,865	"	" May 2, 1904.
Patrie	14,865	La Seyne.	Under trial.
Justice	14,865	"	Launched Oct. 27, 1904.
Vérité	14,865	Bordeaux.	Building.
Liberté	14,865	St. Nazaire.	Launched April 19, 1905.
A 15	18,000	Brest.	To be begun in 1906.
A 16	18,000	La Seyne	" " " " "
A 17	18,000	Lorient	" " " " "
A 15 bis	18,000	"	" " " " "
A 16 bis	18,000	"	" " " " "
A 17 bis	18,000	"	" " " " "
Armored Cruisers.			
Ernest Rénan	13,644	St. Nazaire.	Launched April 9, 1906.
Jules Michelet	12,550	Lorient.	" Aug. 31, 1905.
Victor Hugo	12,550	"	Under trial.
Edgar Quinet	13,644	Brest	Building.
Waldeck Rousseau	13,644	Lorient	"

THE NEW BATTLESHIPS.—In a supplementary report to the French naval budget, indications are given as to the laying down of the six battleships which have been authorized for this year—three additional to the three first proposed. The budget committee has approved the financial arrangements, and thus the minister is authorized to continue or undertake in the dockyards or in private establishments the six vessels indicated. The three contained in the original estimate were known as *A15*, *A16*, and *A17*, and the additional ships are to be described as *A15 bis*, *A16 bis*, and *A17 bis*. These vessels are to be completed within four years, and, in order that this may be done, orders are to be given simultaneously to all firms supplying material. The addition of the three battleships will not increase the credit required for the year, and the armored cruisers will not be laid down at present. It appears that M. Lhomme is preparing the plans of the four ships which are to be built in private yards. Of the others two will be laid down at Brest and Lorient. Apparently all the six ships will be identical. The range of action at nineteen knots, which is to be the maximum, will be 1900 miles with 2050 tons of coal, of which 1085 tons will be in excess of the normal supply. The normal supply of 965 tons gives a range of action of 4000 miles at ten knots and 925 miles at the maximum speed.—*Army and Navy Gazette.*

The six new French battleships which are to be laid down this year will, according to the *Temps*, have a displacement of 18,000 tons. Their length will be 145 meters (578 ft.), their beam 25.65 meters (84 ft.), and their maximum draft 8.44 meters (28 ft.). The engines are to be of 22,500 horsepower, giving a speed of 19 knots. The radius of activity with a normal supply of coal will be 4000 miles at ten knots, or 925 miles at the maximum rate of speed, while with the extra supply which it will be possible to carry, these distances will be 8500 miles and 1900 miles respectively. The armament will consist of four guns of 305 millimeters (12 in.), twelve of 240 (9½ in.), sixteen of 75 (3 in.), and eight of 47 (1¾ in.). It will further include two under-water discharge tubes for torpedoes. The complement will comprise 31 officers and 690 men. They are to be finished in four years.—*Page's Weekly.*

In the recent discussion upon the French navy estimates Admiral Bienaimé proposed that the battleship *A16*, which it is intended to build in a private yard, should be constructed instead in the arsenal at Toulon. He pointed out that of the six battleships to be laid down one is assigned to Brest, and another to Lorient, while the remaining four are to be built in private establishments, and he produced figures to show that the dockyards build much more cheaply than the private yards, so that something more than £200,000 might be saved by laying down one of the ships at Toulon. At the present time French naval construction costs about 25 per cent more than the like work does in foreign countries, and Admiral Bienaimé attributes this to the failure to bring the arsenals into competition with the private yards. He instanced the case of the foundry at Guérigny, which was able some years ago to enter into competition with private industries in the manufacture of armor, the result being that armor for deck protection which cost from 1700 francs to 1800 francs per ton was executed at Guérigny at a cost of 560 francs per ton. The Admiral estimated that at least 20 per cent might be saved, but his proposals were not adopted. M. Thomson, the Minister, said an attempt had been made to specialize the arsenals, the more important work being assigned to Brest and Lorient, while Toulon was given up to repairs and the building of the smaller classes of vessels, and even if the number of workmen there were increased, it would be impossible to construct at the same time the large vessels. There are evidently two points of view, and the decision of the Minister is in conformity with the policy which his predecessors inaugurated.—*Army and Navy Gazette.*

The *Moniteur de la Flotte* states that the six new French battleships of 18,000 tons are to be named *Voltaire, Diderot, Condorcet, Vergniand, Mirabeau,* and *Danton.* Of these the first four are to be built in private shipyards, and the last two in the arsenals at Brest and Lorient respectively.

M. THOMSON ON FRENCH NAVAL AFFAIRS.—On Thursday, March 15, M. Thomson, the French Minister of Marine, resumed, in the Chamber, the speech interrupted by the political crisis. Amongst the more interesting features of his harangue were the following:

Torpedo Tubes for Battleships.—In the new battleships the two tubes to be provided have been the subject of some criticism. The Parliamentary Budget Committee opposed them, but the General Staff are not of that opinion. It is said that at Tsushima many torpedoes were launched with but trifling result. That is possible, but engagements are not always fought under similar conditions, and now that torpedoes are improving, and may shortly be expected to reach a range of 3000 meters, it would be unwise to leave out the tubes.

Submarines.—The qualities to be sought for in connection with submarines have been well stated by Admiral Fournier, to whom France owes most of the progress made in submarine matters since 1901. What is looked for is a large sea-going submersible, with a radius of 2500 or 3000 miles. No such vessel, however, is contemplated in the present budget.

Gunnery.—The Russo-Japanese War has shown that the naval battles of the future will be fought at greater distances. Hence the importance of telescopic sights. Five battleships are so fitted already, and the rest will be by May 15, so far as guns of 8-inch caliber and upwards; the remainder by the end of the year. A special school is to be established for gunnery practice at long ranges, and greater attention paid to gunnery training generally.

Naval Maneuvers.—The principal lesson of the Russo-Japanese War is the necessity of efficiency in the personnel, and to attain this maneuvers are indispensable. These have, therefore, been re-established.

An Additional Battleship Necessary.—Although only six new battleships were now proposed, the number really required was seven. The Minister hoped that the seventh battleship would be asked for and obtained next year.—*United Service Gazette.*

The French battleship *République* is now rapidly approaching completion at Brest, having received all her armament, and should be ready within a short time for her trials. In the *Démocratie,* which is also building at the same port, the turrets and mountings for the 12-inch guns are already in place, so that she, too, is well advanced. The *Dupuy de Lôme* has been reconstructed and modified in external appearance. She has now only one fighting mast instead of two, and has three funnels instead of two. She has been supplied with Du Temple small-tube boilers, like those in torpedo-craft.—*Army and Navy Gazette.*

The *Ernest Renan,* the largest armored cruiser ever constructed for the French navy, was successfully launched on April 9 at Saint-Nazaire. She is one of five vessels of this class provided for in the 1900 shipbuilding programme, which, together with six battleships, were to have been completed before December 31, 1905, but not one was ready for service at that date. The delay in connection with the *Ernest Renan* is said to be largely due to the plans having been overhauled and radically altered at the last moment. To attain a speed of 23 knots instead of 22 the tonnage had to be increased from 12,550 to 13,644, and four out of the sixteen 164-millimeter guns done away with. The cost of the vessel, originally estimated at 29,000,000 fr., will be 32,000,000 fr., and she will probably be ready for her trials in June, 1907. The launching of the *Ernest Renan* gives France a fresh advantage over Germany—as far as vessels of her class are con-

cerned. The French Atlantic Fleet has fifteen armed cruisers against Germany's ten; but the German people boast their superiority in first-class battleships.—*United Service Gazette.*

The French are about to put in hand two armored destroyers of 440 tons and 25 knots.—*Engineer.*

Le Yacht states that the armored coast guard ship *Tonnerre* has been turned over to the Squadron of the North to serve as a target in battle practice.

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Lothringen	13,200	Danzic.	Under trial
Pommern	13,200	Stettin.	Launched Dec. 2, 1905.
Hannover	13,200	Danzic. (Schichau Works.)	" Sept. 26, 1905.
Q	16,000	Kiel.	Building.
R	16,000	Danzic.	"
Ersatz Bayern	19,000	.....	Ordered.
" Sachsen	19,000	.....	"
Armored Cruisers.			
C	11,000	Bremen.	Building.
Scharnhorst	11,600	Hamburg.	Launched March 22, 1906.
E	15,000	.....	Ordered.
Protected Cruisers.			
Danzic	3,200	Danzic.	Launched Sept. 22, 1905.
Koenigsberg	3,200	Kiel.	" Dec. 1905
Leipsig	3,200	Bremen.	" Mar. 22, 1905.
O	3,400	Danzic.	Building.
Ersatz Wacht	3,400	Stettin.	"
" Blitz	3,400	Kiel	"
" Pfeil	3,500	.....	Ordered
" Komet	3,500	.....	"

THE PAST NAVAL YEAR.—During 1905 the two new first-class battleships *Preussen* and *Hessen*—two of the *Braunschweig* class—each of 13,200 tons displacement, have been completed, commissioned, and taken their place in the 2d squadron of the active battle fleet; two first-class armored cruisers, the *Roon* and *Yorck*, of 9500 tons displacement each, have also been completed; the latter having finished her trials has taken her place as flagship of the rear admiral commanding the scouting (cruiser) squadron of the battle fleet, while the former, as soon as her trials are completed, will become the flagship of the commodore commanding the 2d division of the squadron; in addition, three small cruisers, the *Berlin*, *München*, and *Lübeck*, have been completed; of these the first-named has joined the 2d division of the scouting squadron, while the other two are still carrying out a series of competitive trials, the *Lübeck* being fitted with turbines.

Approaching completion are the two first-class battleships *Lothringen* (the last of the *Braunschweig* class) and *Deutschland*, of 13,200 tons displacement, both launched in 1904, while two others of the same class, the *Hannover* and *Pommern*, were launched last year. No armored cruiser was launched, but three small cruisers, the *Leipzig*, *Danzic*, and *Königsberg*, took the water. Building and to be launched this year are the two battleships *Q* and *R*, also of 13,200 tons—under construction at the Schichau Yard, Danzic and the Germania Yard, Kiel, respectively—which will bring the number of this group of powerful battleships up to ten, the last five, in which the *Deutschland* is included, being slightly superior in some details in their armor protection to their five predecessors of the *Braun-*

schwerig class. There are also building two first-class armored cruisers, *C* and *D*, of 11,500 tons displacement, laid down last year in private yards at Bremen and Hamburg, respectively, and three small cruisers, the *Ersatz Meteor*, *Ersatz Wacht*, and *Ersatz Blitz*.

It is further proposed to lay down during the current year two more battleships, which are to have, roughly, a displacement of 15,000 tons,* which are to replace the old third-class battleships *Baiern* and *Sachsen*, launched as long ago as 1878; a first-class armored cruiser, *E*, of 12,000 tons displacement; two third-class cruisers, and two torpedo destroyer divisions of six boats each. The two third-class cruisers are to replace the old despatch-vessels, *Pfeil* and *Komet*, launched in 1882 and 1892 respectively.

The following table gives a list of the ships completed and under construction last year and to be laid down this:

Name.	Type.	Displacement.	Date when laid down, launched, or completed.
Preussen	Battleship	13,200	Completed 1905.
Hessen	"	13,200	" 1905.
Lothringen	"	13,200	Launched 1904.
Deutschland	"	13,200	" 1904.
Hannover	"	13,200	" Sept. 29, 1905.
Pommern	"	13,200	" Dec. 2, 1905.
Q[1]	"	13,200	Begun 1905.
R[1]	"	13,200	" 1905.
Ersatz Bayern	"	18,000	To be begun 1906.
Ersatz Sachsen	"	18,000	" 1906.
Roon	Armoured Cruiser	9,500	Completed 1905.
Torek	"	9,500	" 1905.
C	"	12,000	Begun 1905.
D[1]	"	12,000	" 1905.
E	"	12,000	To be begun 1906.
Lübeck	Protected Cruiser	3,200	Completed 1905.
Berlin	"	3,200	" 1905.
München	"	3,200	" 1905.
Leipzig	"	3,200	Launched Mar. 22, 1905.
Danzig	"	3,200	" Mar. 22, 1905.
Ersatz Meteor	"	3,200	Begun 1905.
O[1]	"	3,200	" 1905.
Ersatz Wacht	"	3,200	" 1905.
Ersatz Blitz	"	3,200	" 1905.
Ersatz Pfeil	"	3,200	To be begun 1906.
Ersatz Komet	"	3,200	" 1906.

[1]Details uncertain.

The Supplementary Navy Bill laid before the Reichstag last autumn allows for the construction between the present year and 1917 of eighteen battleships, thirteen armored and twenty-four small cruisers, the navy law of 1900 having allowed for each of these classes, seventeen, ten, and twenty-nine vessels respectively; seventeen of these battleships will replace older vessels, viz., the four ships of the *Sachsen* class, the *Oldenburg*, the eight

*These new battleships are now reported to be of 19,000 tons, and the new armored cruiser *E* of 15,000 tons.—EDITOR.

coast-defence vessels of the *Siegfried* class, and the *Brandenburg*, with her three sisters. In addition, the sixteen destroyer divisions of six boats each (96 boats), which are being and to be constructed under the bill of 1900, are to be increased to twenty-four divisions, making a total of 144 boats.

The building programme, 1906-1917, is to be carried out as follows:

Year of First Vote.	Navy Act and Supplementary.			Destroyer Divisions.	Cost of Construction and Armament.		
	Battleships.	Cruisers.			Million Marks.		£
		Large.	Small.				
1906	2	1	2	2	117	=	5,728,125
1907	2	1	2	2	131		6,413,542
1908	2	1	2	2	136		6,658,333
1909	2	1	2	2	145		7,098,958
1910	2	1	2	2	148		7,245,832
1911	1	2	2	2	147		7,196,874
1912	1	2	2	2	144		7,050,000
1913	1	1	2	2	137		6,707,291
1914	1	1	2	2	126		6,168,750
1915	1	1	2	2	119		5,826,041
1916	1	1	2	2	112		5,483,334
1917	2	—	2	2	113		5,532,292
	18 Including one still to be built under Act of 1900.	13 Including the six Armoured Cruisers under the Supplementary Act, 1906.	24 Including one still to be built under Act of 1900.	24	—		—

—*Etat für die Verwaltung der Kaiserlichen Marine, 1906.* (Translation from *United Service Institution.*)

The new third-class cruiser *Ersatz Wacht* is to be built at the Vulcan Yard, Stettin, and to be fitted with turbine engines, which will be supplied by the German Turbine Parsons Company. They are to develop 13,600 I. H. P., as against the 11,600 I. H. P. of the *Lübeck*, and are estimated to give her a speed of 24 knots, as against 23 of the last-named ship. Her displacement will be 3410 tons, against the *Lübeck's* 3250; her length 354 feet 2 inches; her beam 42 feet 3 inches, and her draft 13 feet 9 inches; she is thus 12 feet longer and 3 inches more beam than the *Lübeck*. It is understood that the dimensions and speed of the two other third-class cruisers, the *Ersatz Pfeil* and the *Ersatz Komet*, will be the same as those of the *Ersatz Wacht*, but they will be fitted with reciprocal engines.

The five protected cruisers of the *Hertha* class are being modernized, at a cost of £50,000 each; among other improvements, they are to be fitted with water-tube boilers. The *Freya* and *Veneta* were taken in hand last year, and work on the *Hertha* and *Victoria* will be commenced as soon as the necessary sum has been voted by the Reichstag. The *Hansa*, the fifth of the class, is at present in China. These vessels have a displacement of 5800 tons and a speed of 18.5 knots. Their armament, which consists of two 8.2-inch Q. F. and eight 5.9-inch Q. F. guns, is protected by armor.

the 8.2-inch guns in hooded barbettes of 3.9-inch steel, one forward and one aft, and the 5.9-inch Q. F. guns, four in turrets and four in casemates, 3.9-inch thick, with 3.1-inch ammunition hoists. The fore conning-tower is protected by 8-inch armor, and the after by 3.9-inch, while there is a funnel glacis 4.7-inch thick.—*Marine Rundschau* and *Neue Preussiche Kreuz Zeitung*. (Translation from *United Service Institution*.)

The *Moniteur de la Flotte* states that the new German constructions are to have the following characteristics: Battleships—19,000 tons displacement, 19.5 knots speed, sixteen 28-cm. guns of 50 calibers length, 12-inch armor belt. Cruisers—15,000 tons displacement, 22.5 knots speed, eight 28-cm. and six 16-cm. guns, 8-inch armor belt.

Le Yacht gives the same displacements as above for the new German ships, but does not give any details as to their armament, etc.

The armored cruiser *D*, which has been named *Scharnhorst*, was launched on March 22. She is to be finished in 1907 and her sister ship *C* is to be launched shortly. These ships are of 11,600 tons displacement. They carry eight 21-cm. guns, four in two middle line turrets and four at the corners of an armored redoubt; also six 15-cm. and twenty 8.8-cm. guns.

The secret German battleships, *Ersatz Baden* and *Ersatz Sachsen*, are smaller than all the secrecy about them suggested. The exact displacement in metric tons is 17,710, which is approximately 17,500 in our measurements. The speed will be, it is hoped, 19.5 knots, and the armament is provisionally fixed at fourteen 11-inch 50-caliber guns. The cruiser to be built is 14,760 tons, and will probably carry six or eight 11-inch and some 6-inch guns. She is practically the *S* battleship that was to have been built, enlarged somewhat to give more speed.—*Engineer*.

The discussion of the naval estimates has brought out the following facts in regard to the personnel: In 1906 Germany counts 1470 officers and 31,738 men. The officers are 25 admirals, 71 captains, 151 commanders, 379 lieutenant-commanders, 459 lieutenants, and 349 junior lieutenants. France has 1729 officers and England 2755. France has 29.9% flag and commanding officers, England 24.9%, and Germany but 16.8%. The estimated German naval personnel for 1920 is 2520 officers and 66,838 men.—*Le Yacht*.

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Dreadnought	18,000	Portsmouth.	Launched Feb. 10, 1906.
Lord Nelson	16,500	Jarrow (Palmer).	Building.
Agamemnon	16,500	Glasgow (Beardmore).	"
Africa	16,350	Chatham.	Under trial.
Britannia	16,350	Portsmouth.	Launched Dec. 10, 1904.
Hibernia	16,350	Devonport.	" June 17, 1905.
Armored Cruisers.			
Minotaur	14,600	Devonport.	" June 6, 1906.
Shannon	14,600	Chatham.	" May 20, 1905.
Defence	14,600	Pembroke.	Building.
Warrior	13,500	Pembroke.	Launched Nov. 25, 1905.
Cochrane	13,500	Glasgow.	" May 20, 1905.
Natal	13,500	Barrow.	" Sept. 30, 1905.
Achilles	13,500	Newcastle.	" June 17, 1905.
Invincible	15,000	Newcastle.	Ordered
Inflexible	15,000	Clydebank.	"
Indomitable	15,000	Glasgow.	"

THE NAVY ESTIMATES, 1906-1907.—The estimates for 1906-1907 amount to £31,869,500, as opposed to £33,389,500 for the current year, a reduction of £1,520,000. The method by which this reduction has been obtained is described in one of the appendices (estimates committee) to the Blue Book, "A Statement of Admiralty Policy" (Cd. 2791), issued in November last, anticipating much of that usually made on presentation of the estimates. The present estimates are substantially in agreement with the forecast given in that statement.

The following is the statement relative to new construction during the last twelve months:

New Construction.—Between April 1, 1905, and March 31, 1906, the following ships have been completed and become available for service: Three battleships, *Dominion, Hindustan, New Zealand;* eight armored cruisers, *Antrim, Argyll, Carnavon, Devonshire, Hampshire, Roxburgh, Black Prince, Duke of Edinburgh;* one second-class cruiser, *Encounter;* eight scouts, *Adventure, Attentive, Forward, Foresight, Pathfinder, Patrol, Sentinel, Skirmisher;* sixteen destroyers, thirteen submarines, one floating coal depot.

On April 1, 1906, there were under construction: Six battleships, ten armored cruisers, twelve destroyers (coastal), five destroyers (ocean-going), one destroyer (very fast ocean-going), one royal yacht, fifteen submarines, and a repair ship.

It is proposed to begin during the financial year, 1906-1907: Four armored vessels, five destroyers (ocean-going), twelve destroyers (coastal), twelve submarines.

Battleships.—The committee on designs, mentioned in last year's statement, considered the various designs, and settled the type of battleship to be laid down during the financial year, 1905-06. This battleship, *Dreadnought,* is being supplied with turbine machinery on the Parson's system, and was laid down at Portsmouth on October 2, 1905, and launched on February 10 by His Majesty the King. It is hoped that the ship will be put into commission in the beginning of 1907.

The *Lord Nelson* and *Agamemnon,* of the 1904-05 programme, which are now under construction on the Tyne and Clyde respectively, have made considerable progress during the year, and it is expected that they will be completed by their contract dates.

The decision to rearrange the armament in the *Warrior* class has somewhat delayed their completion.

Armored Cruisers.—The six armored cruisers of the *Devonshire* class have passed successfully through their trials, and all of them are in commission. They attained an average speed of over 23 knots, and one reached 23.6 knots. They are practically identical in speed and coal endurance with the cruisers of the *Monmouth* class, but are superior in armament and protection.

The *Duke of Edinburgh* has successfully passed through all her trials, and attained a speed of 22.84 knots in rough water and a strong wind on the measured course at Polperro. She has been completed at Pembroke, and was commissioned with a nucleus crew on January 20, 1906.

The *Black Prince* has also passed through all her principal trials successfully, attaining a speed of 23.65 knots in fine weather on the Polperro course.

The four later ships of the *Duke of Edinburgh* class, which have an auxiliary armament of 7.5-inch instead of 6-inch guns, have all been launched during 1905-06.

The three armored cruisers of the *Minotaur* class, which were laid down during January and February of 1905, have made good progress.

During the current financial year, contracts have been entered into for the construction of three armored cruisers, named *Invincible, Inflexible, Indomitable.* These vessels, are to be ready for commission in May, 1908, *i. e.,* within 30 months from the date of ordering.

Scouts.—All the eight vessels of the new *Scout* class have been satisfactorily completed and put into commission. These vessels have fulfilled all the conditions of the designs, and have obtained speeds for 6½ hours' continuous steaming varying from 25.06 knots to 25.88 knots. The eight vessels have been built from four different designs.

Destroyers.—All the vessels of the *River* class which were under construction at the commencement of the current financial year have been completed and put into commission, making in all thirty-four vessels of this class now in service.

The strength and sea-going capabilities of this class have been severely tested, and have proved very satisfactory.

The twelve coastal destroyers and the five ocean-going destroyers included in the current year's programme have all been ordered. The former will have a trial speed of 26 knots and the latter of 33 knots. Negotiations in connection with ordering one special ocean-going destroyer of 36 knots trial speed are nearly complete.

The whole of the destroyers included in this year's programme will have turbine machinery, and be fitted for carrying and burning oil fuel.

Other Vessels.—The design of a new yacht for His Majesty has been completed, and the actual building is in hand on the Clyde.

The steamship *Indrabarah,* now named *Cyclops,* has been purchased for conversion into a fleet repair ship.

Submarines.—The eleven boats in the present year's programme have been ordered.

Machinery and Boilers.—The policy of fitting complete installations of water-tube boilers in warships has been continued, large tube boilers of Babcock & Wilcox or Yarrow type being fitted in battleships and first-class cruisers, and boilers of the small tube type being fitted in scouts and destroyers.

The conditions adopted last year, under which all contractors' machinery trials in new ships were to be carried out under service conditions, have been applied to all later ships.

The policy of providing reserve sets of auxiliary machinery, etc., has been continued during the past year by the provision of further auxiliary machinery, etc., typical for various classes of ships, and the stock is now practically complete to date. These reserve parts will enable ships to be supplied with replace auxiliary machinery with the least possible delay.

The provision of an adequate supply of fresh water for ships of H. M. fleet has been under continued consideration. Additional evaporating and distilling plant has been supplied to each battleship which was below latest standard in this respect, when coming in hand for large refit.

All new ships are to be supplied with independent machines for ice-making and for cold-storage.

Standardization.—The extended policy adopted last year of making the main and auxiliary machinery of ships of the same class interchangeable as far as possible has been continued, and this plan is being carried out in all later ships, including destroyers.

Electric Generating Machinery.—In consequence of the extension of the application of electric motors for driving auxiliary machinery and for ships' purposes generally where applicable, larger installations of generating machinery are being fitted in vessels under construction, and those on the more modern completed vessels are being increased as the ships are taken in hand for large refit.

Turbine Propelling Machinery.—In view of the satisfactory performances of H. M. S. *Amethyst,* fitted with turbine propelling machinery, and of a rapidly increasing number of such installations in ships of the Mercantile Marine, it has been decided to adopt this means of propulsion in all the war vessels provided for during the present year.

As the result of experience, it has been decided to replace the set of reciprocating machinery fitted in the *Velox* (turbine-propelled torpedo-boat destroyer) for use at low speeds, by turbines adapted for cruising powers.

Liquid Fuel.—The experimental oil fuel establishment at Haslar has been completed, and trials with five of the latest types of water-tube boilers, together with instructional work, are in regular progress there.

The oil fuel installations in the *Mars* and the *Hannibal* are being brought up to date, and, as opportunity affords, oil fuel appliances are being fitted to H. M. ships *Cæsar, Majestic, Magnificent,* and *Victorious.* Installations are also in progress for all the later vessels building and completing.

The torpedo-boat destroyer *Spiteful,* fitted to burn oil fuel only, is in commission as an instructional vessel for the training of engine-room complements in the manipulation of oil-burning appliances.—*United Service Institution.*

It is worthy of note that in two years the cost of the navy has been reduced by over five millions sterling. The following abstract shows the increases and decreases as compared with the corresponding votes for last year:

Votes.	——	Net Estimates.		Increase.	Decrease.
		1906-07.	1905-06.		
	I. NUMBERS.	Total Numbers.	Total Numbers.		
A	Officers and men	129,000	129,000		
	II. EFFECTIVE SERVICES.	£	£	£	£
1	Wages, etc	6,810,700	6,672,000	138,700	—
2	Victualling and clothing	2,053,200	2,256,600	—	203,400
3	Medical services	275,500	277,500	—	2,000
4	Martial Law	14,700	14,000	700	—
5	Educational Services	165,600	161,900	3,700	—
6	Scientific Services	65,100	69,300	—	4,200
7	Royal Naval Reserves	426,600	420,600	6,000	—
8	Shipbuilding, Repairs, Maintenance, etc:				
	Personnel	2,407,600	2,768,300	—	360,700
	Matériel	2,827,200	4,816,900	—	1,989,700
	Contract work	8,588,400	7,827,800	760,600	—
9	Naval Armaments	2,986,000	2,986,000	—	—
10	Works, Buildings, and Repairs	1,954,500	1,905,200	49,300	—
11	Miscellaneous Services	482,200	454,000	28,200	—
12	Admiralty Office	351,500	336,400	15,100	—
	Total	29,408,800	30,966,500	1,002,300	2,560,000
	III. NON-EFFECTIVE SERVICES.				
13	Half-Pay, Reserved and Retired Pay	820,700	800,900	19,800	—
14	Pensions, Gratuities, and Allowances	1,256,300	1,233,900	22,400	—
15	Civil Pensions and Gratuities	383,700	388,200	—	4,500
	Total	2,460,700	2,423,000	42,200	4,500
	Grand Total	31,869,500	33,389,500	1,044,500	2,564,500

Net decrease.....£1,520,000.

The supply of guns during 1905-06 is reported to have been satisfactory. Improvements have been effected in the designs of recent guns, and steel of greater tensile strength and higher tenacity has been introduced both for new guns and for the repair of the older patterns. The difficulties which have been met with in the manufacture of armor-piercing shell of a new pattern have been surmounted, and these projectiles have now been generally supplied to the fleet. There have also been effected improvements in gun mounting, and in the sights, while the supply of the necessary instruments for enabling fire to be opened with accuracy at long ranges which was begun last year, is now well advanced, and the considerable number of ships already fitted with these instruments should show in the returns of battle practice during 1906.—*Page's Weekly.*

A statement is included showing the contributions from India and the Colonies towards naval expenditure as under:

India	£103,400
Australian Commonwealth	200,000
New Zealand	40,000
Cape Colony	50,000
Natal	35,000
Newfoundland	3,000
	£431,400

The Australian contribution is the largest, and is in part for the maintenance of the Australian squadron.

Accompanying the estimates is the usual statement of progress. No support is given to the rumor as to the abolition of the coastguard. It is remarked in this connection:

"The reorganization scheme of 1903 is now fully established, and works very satisfactorily. New coastguard instructions have been completed and issued.

"A considerable reduction has been made during the last year in the personnel and the buildings of the coastguard.

"Stations which required extensive repairs, or where the quarters were found no longer suitable, have been closed.

"The estimated numbers of the coastguard personnel for 1906-07 will be 4122, as compared with 4369 for 1905-06."

In connection with the naval reserves the following paragraphs occur:

"The sea-going Royal Naval Reserve drill ships have been paid off, as it has been decided to train reserve men in the ships of the divisions in commission in reserve at the home ports.

"After April 1 next the harbor drill ships, with the exception of those at London, Aberdeen, Bristol, and Liverpool, will be discontinued. Five of the torpedo gunboats are being transferred from the admiral commanding the coastguard and reserves to the admiral of the torpedo-craft flotillas. The number of Royal Naval Reserve officers and men having reached requirements, entries have been temporarily suspended during the year.

"Early in the financial year 1905-06 three months' training on board the ships of the reserve divisions was substituted for training on board special sea-going drill ships, allowing the latter to be withdrawn, and thereby effecting a large economy. It also tended to greater efficiency, as the ships of the reserve divisions are more efficiently armed vessels.

"Considerable alterations in the system of training officers and men of the Royal Naval Reserve will come into force on April 1 next. All drill and training are in the near future to be carried out in effective ships in commission, instead of at shore batteries and in harbor drill ships."

On the other hand, the establishment of the corps of the Royal Marines is to be pruned. In this connection it is stated:

"It was decided to reduce the establishment during the current financial

year from 19,800 to 18,261—*i. e.*, by 1539; of this reduction 200 will be in the Royal Marine Artillery and 1339 in the Royal Marine Light Infantry."

As to other details of naval progress, it is stated:

"The completion of the Boys' Training Establishment at Shotley has enabled the Admiralty to carry out their policy of paying off the old training ships and concentrating the training of boys. The training of boys on entry is now practically divided between Shotley and Plymouth, a very few boys being still entered in the *Emerald* at Queenstown.

"The Royal Naval School of Music, which was established in 1903, has made steady progress during the year. The present number of band ranks for service afloat has reached 950, the number originally authorized to be borne during the financial year. Twenty-seven bands under the new scheme are now embarked in His Majesty's ships.

"Improved appliances for cooking, as well as bread bakeries, are being introduced into ships.

"Improved sanitary, ventilating, warming, and washing arrangements are also being introduced.

"The use of electricity for many purposes on board His Majesty's ships continues to increase.

"With a view to reducing the numbers of non-swimmers in the fleet, directions have been issued for general swimming instructions to be given for half an hour daily in all ships, and for arrangements to be made in suitable localities for parties of non-swimmers to be sent away for instruction to swimming baths, etc. The test of ability to swim has also been raised, and arrangements have been made for advanced classes in life-saving to be formed among the more proficient swimmers."—*United Service Gazette.*

MINE WORK AT SEA.—The ships of the Channel fleet, now at Portland, carried out some instructive submarine mining exercises while they were in the vicinity of Bantry Bay. The operations included the simultaneous explosion of four tons of guncotton, and the experiments, it is understood, again demonstrated the great value of the mine as a weapon of warfare. The operations extended over several days, the crews of the various ships being exercised first in the laying of E-M mine-fields and particularly in the location and recovery of mines, the position of which was unknown. After these operations had been carried out, the mines were taken on board the *Ocean* and *Triumph* to be prepared for firing. An E-M mine-field was laid by the *Jupiter,* and on the following morning eighteen 500-lb. counter-mines were laid. These were in two lines, nine mines in each line.

The work was carried out under the superintendence of Commander V. H. S. Haggard, of the *Cæsar,* with Lieutenant H. E. Browne, of the *Ocean,* and Lieutenant W. H. Elder, of the *Triumph,* in charge of the lines of mines. When all was ready, the counter-mines were fired, and the concussion discharged the mine-field that it was desired to clear. The tremendous explosion shot an enormous body of water high into the air. When the waters were again settled the surface was strewn with fish killed or stunned by the concussion. The period from the time of slipping the battery boat until the firing of the mines was some seconds short of five minutes, which is considered by the authorities as a very creditable performance, especially in view of the fact that in case of warfare the work would probably have to be effected under fire. The results of the experiments are said to be eminently satisfactory, and from this it may be gathered that the whole of the mine-field was destroyed, though on this point the greatest secrecy is maintained. Vice-Admiral Curzon-Howe watched the operations from his barge, and expressed satisfaction with the manner in which they were carried out.

Later, during the temporary absence of the first division of the fleet, which had left for Galway Bay for firing practice with the quick-firing

guns, an E-M mine-field of forty mines, fitted with special blowing charges, was laid at the anchorage, which on their return the division had to locate. The importance of these operations cannot be exaggerated, as the amount of practical knowledge that is imparted in carrying them out is invaluable both to officers and men.—*United Service Gazette.*

NEW CODE OF SIGNALS.—The new code of signals in the navy will be brought into use during the forthcoming maneuvers. It is understood that the greater part of Volume II of the Fleet Signal Book is cancelled, and that pennants only will be used in maneuvering signals for the future, a change in the direction of greater simplicity.—*United Service Gazette.*

The cruiser *Duke of Edinburgh* has completed her continuous steaming trials, having been twenty-six hours under way, during twenty-four of which coal was burnt in the boilers, and oil fuel for the remainder of the time. The test with oil fuel is a condition recently imposed by the Admiralty, and in the case of the *Duke of Edinburgh* it is reported to have given reasonable satisfaction. The speed of the ship varied between eleven and seventeen knots, and as the result of the trial, the propelling and other machinery will be taken over by the Admiralty from Messrs. Hawthorn, Leslie and Co.

The announcement is made that British battleships and cruisers are to be provided with searchlights of much greater power, and of 36-inch diameter mirrors, controlled entirely by electric motors.

Successful experiments are said to have been carried out on board the battleship *Jupiter* with a mixture of Scotch coal and oil fuel.—*Page's Weekly.*

Of the new British submarines to be laid down, one will be of a new type *C*, which will have superior radius to the *B* class and better accommodation. She will be far and away the most perfect submarine in existence.—*Engineer.*

Good progress, according to the *Telegraph's* naval correspondent, is being made with the development of British submarine flotillas, and a new depot, with a parent ship and half a dozen of these under-water craft, is about to be established at Dover. The vessel assigned to this duty will be the *Forth*, one of the existing "mother" ships. In order to set free this cruiser for service at Dover, the second-class cruiser *Bonaventure* is about to proceed to Haulbowline Dockyard, where she will be refitted in readiness to become the headquarters at Devonport. She will provide accommodation for the officers and men, and will be equipped with storage room for petrol and with a complete workshop plant for the purpose of carrying out repairs.—*Page's Weekly.*

A curious *impasse* is reported from the Mediterranean, where Lord Charles Beresford has issued a stringent memorandum on the subject of coal consumption. This memorandum points out that economy of coal consumption may mean everything in war time, and consequently the consumption of every ship is to be duly recorded and circulated with honors to the smallest consumption per horsepower and blame to the largest. Hence the trouble, because under normal conditions Belleville boilered ships burn less coal than the others, and a relatively slack engineering staff may so find itself occupying an unduly high place against some non-Belleville ship. In order to adjust this matter fairly, it is proposed to have some kind of handicap, so that the careful staff in a "coal eater" shall earn the reward due to their exertions. The absence of some such rule has hitherto ruined all attempts at putting coal consumption on the same lines as coaling record competitions.—*Engineer.*

THE ROYAL NAVAL COLLEGE AT OSBORNE.—When our next great naval engagement is fought we shall realize a great deal better, the true meaning of naval training, and just as the moralist turned from Waterloo to the playing fields of Eton, so attention may and probably will be directed to the training of our naval cadets at Osborne; we hope so. It is, at any rate, impossible to overestimate the importance of everything relating to the selection of embryo officers, and in view of the misleading statements which have appeared in the press as to the admission of cadets to Osborne, we are glad to note the definite statement which Lord Tweedmouth was able to make on April 3, setting forth the exact conditions followed. The age at which a boy will enter the establishment will remain thirteen, but it is proposed that he shall come before the interviewing committee in the four or five months immediately preceding his arrival at that age. In this way thirteen will become the uniform age at which a cadet will enter Osborne. Lord Tweedmouth wished to dispel the idea that entrance into Osborne was to be gained by patronage, favoritism, and all sorts of improper means. That was not the case at all. The system which was adopted for the entry of cadets to Osborne was very open and exceedingly fair in its operation. There was no necessity for nomination to Osborne. It was perfectly open to the parent or guardian of any boy who wished to enter Osborne to get the boy brought before the interviewing committee. What the parent or guardian had to do was to make application to the Admiralty, who sent a form which had to be filled up with certain particulars about the boy. The only conditions attached were that the parent or guardian should state that the candidate was willing to enter any of the three branches of the service; that it was the intention, if the candidate obtained a cadetship, that he should adopt the navy as his profession; and that the guardian should be prepared to pay in advance quarterly £75 a year as well as personal expenses while the boy was going through the naval colleges, and provide him with an allowance of £50 a year from the date of leaving Dartmouth to the time he became an acting sub-lieutenant. These were the only conditions required in order to obtain the boy admission to the interviewing committee. These committees were held three times a year in February, June, and October. The reports of the committee and medical officer were laid before a small committee at the Admiralty. The boys selected to go up to the qualifying examination were chosen absolutely on the faith of the reports thus brought before the First Lord and his advisers. He did not think it possible to conceive a fairer way of arriving at a decision with regard to boys of that very young age.

It was sometimes said that the cadets at Osborne were drawn from a very limited class. He had asked for a return, so far as it could be made out, of the parentage of the boys who had gone to Osborne since its foundation. Of these boys eleven were sons of peers, 161 sons of army officers, eighty-eight sons of naval officers, eighty-three sons of clergymen, sixty-seven sons of merchants and manufacturers, thirty-one sons of barristers, forty-seven sons of solicitors, forty-six sons of medical men, forty-nine sons of civil servants, thirty-one sons of engineers and architects, fourteen sons of schoolmasters, university professors, and the like, twenty-four sons of chartered accountants, stockbrokers, and members of Lloyd's, seventeen sons of bank managers and clerks, ten sons of brewers, fourteen sons of land agents, fourteen sons of colonial landowners and planters, ninety sons of county gentlemen and farmers, and forty-eight were classed as independent and eleven as miscellaneous. Osborne, he thought, could not be accused of being conducted on a class system.—*Page's Weekly.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Roma	12,625	Gov't Yard, Spezia.	Building.
Napoli	12,625	" " Naples.	Launched Sept. 10, 1905.
Vittorio Emanuele	12,625	" " Castellamare.	" October 1, 1904.
Regina Elena	12,625	" " Spezia.	" June 19, 1904.
Armored Cruisers.			
San Giorgio	10,000	Gov't Yard, Castellamare.	Building.
San Marco	10,000	" "	"
Pisa	10,000	.....	Projected.
Amalfi	10,000	.....	"

The naval expenditure of Italy for 1906-07 is officially estimated at $27,850,795. The force which Italy proposes to maintain in the Mediterranean comprises ten fighting ships, twelve torpedo-boats, and six torpedo-boat destroyers. An Atlantic division, comprising two battleships, is also contemplated, as well as a reserve, comprising six fighting ships, to be armed for three months of the year, and six torpedo-boat destroyers, to be also armed for three months. Italy further proposes to maintain seventy-two second-class torpedo-boats as a defensive force. A considerable number of old vessels are about to be sold out of the Italian navy. —*Nautical Gazette.*

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Kashima	16,500	Elswick.	Under trial.
Katori	16,500	Vickers.	" "
Satsuma	19,000	Yokosuka.	Building.
Aki	19,000	Kure.	"
Armored Cruisers.			
Ikoma	13,000	Kure.	Launched April 9, 1906.
Tsukuba	13,000	"	" Dec. 26, 1905
Ibuki	13,000	Yokosuka	Building
Kurama	13,000	"	"
Scouts.			
Tone	2,500	Sasebó	Building
Yodo	2,500	"	"
Nogami	2,500	Nagasaki	"

THE JAPANESE BATTLESHIP KASHIMA.—The two battleships simultaneously ordered early in 1904 by the Japanese Government—one from Sir W. G. Armstrong, Whitworth and Co., Limited, of Elswick, and now known as the *Kashima,* and the other from Messrs. Vickers, Sons and Maxim, Limited, and called the *Katori*—have progressed side by side. The first-named has this week completed her speed trials, while the second wil go on her steam tests during the last week of this month. Both ships will be commissioned in this country, and will sail in company to the Far East. They will form a most powerful addition to the war-worn fleet of the Mikado, representing, if not the last word in battleship design, at all events a splendid advance on even the ships of our *King Edward VII* class.

The *Kashima* has a length between perpendiculars of 425 feet, a beam of 78 feet, and a depth, moulded, of 43 feet 6 inches; with a mean draft of 26 feet 7½ inches, the displacement is 16,500 tons. At this displacement

she carries 750 tons of fuel, but capacity is provided for 2150 tons. The machinery, which was constructed by Messrs. Humphrey, Tennant and Co., Limited, of London, was designed to give the ship a speed of 18½ knots.

The armament, which is of most interest at the present time, is an improvement upon that in the *King Edward VII* class. The vessels were ordered before the war, so that they do not embody such lessons as the operations may have suggested to the Japanese; they are rather developments of British designs. There are four 12-inch breech-loading guns, two mounted in a barbette forward and two aft, while at the four corners of the citadel there are separate 10-inch guns in barbettes. Amidships on the upper deck there is a 6-inch gun on each side, and within a box battery on the main deck five 6-inch guns on each side, making twelve in all. This, it will be recognized, is a more powerful armament than in vessels of the *King Edward VII* class, which have only four 12-inch, four 9.2-inch, and ten 6-inch guns, and, moreover, each weapon of the Japanese ship is of greater power. In the later ships the Japanese have dispensed with the 6-inch gun entirely, and, in addition to four 12-inch guns, have a secondary battery of 10-inch weapons. The machine guns of the *Kashima* include twelve 12-pounder quick-firing guns, three 3-pounders, and six Maxim guns, while, for firing 18-inch torpedoes, there are five submerged torpedo-tubes, which, during the trials, proved efficient when fired with the vessel steaming at 15 and 17 knots.

As to the armor, the water-line belt in the center part of the ship is 9 inches thick, tapering by easy stages to 4 inches, at the bow and stern. The next strake, protecting the citadel containing the 6-inch guns, is of 6 inches thickness, and the armor for the upper deck battery is of 4 inches. The 12-inch gun barbettes are of 9-inch armor for the most part, and 5 inches where the walls are otherwise protected by bulkheads or broadside armor. The 10-inch gun barbettes are of 6 inches, reduced to 2 inches behind the bulkheads. The conning-tower has 9-inch armor, and the observing-tower, which is located above the conning-tower, 5-inch armor.

The triple-expansion engines have cylinders which are respectively 36 inches, 56 inches, and 63 inches in diameter, with a 48-inch stroke. The design follows generally Messrs. Humphrey, Tennant and Co.'s practice, which we illustrated fully in connection with one of the later British warships (see *Engineering*, Vol. LXXIX, page 340). Steam is supplied by twenty water-tube boilers of the latest design of the Niclausse type, the total heating surface being 42,960 square feet, while the working pressure is 430 pounds. The heating surface is therefore equal to 2.23 square feet per unit of power developed. With the exception of the machinery, the whole of the ship, including armor and armament, electric installations, fittings, etc., has been constructed by Sir W. G. Armstrong, Whitworth and Co.

The trials were carried through in a remarkably short period of time. They commenced with a preliminary run on the 3d inst., and were completed in six days. They were conducted in the North Sea, the measured runs being made over the Admiralty course off the mouth of the Tyne. In the first place, a series of progressive speed trials were made over this course, with the average results tabulated below; to these we have added speed results of the 24-hours' trial, and the 8-hours' full-power trial, in order to complete the progressive speeds of the vessel.

Revolutions per minute.	I. H. P.	Speed. Knots.
69.5	3,030	11.136
89	6,275	14.27
102	9,160	16.323
110	11,400	17.204
113.6	13,000	18
123	17,280	19.242

The results at 18 knots represent the mean performance during the 24-hours' trial at four-fifths full power, which is supposed to give the continuous steaming performance of the ship, while the details for the 19.242 knots are the average results attained during four runs over the measured course, while the vessel was running her full-power trial of eight hours' duration. Following upon the four hours, she continued at the same revolutions until the end of the sixth hour, when the engines were speeded up to nearly 125 revolutions, and this continued for two hours; the average speed during that period was probably 19½ knots. In any case, the speed results are exceptionally favorable; the contract required 18½ knots, with the engines indicating 15,600. The mean for the eight hours was therefore three-quarters of a nautical mile per hour higher for an excess of power of 1680 indicated horsepower.

As to the coal consumption, the result on the 24-hours' continuous-steaming trial at 18 knots was 1.86 pound per indicated horsepower per hour, and, on the 8-hours' full-power run, 2.12 pounds per indicated horsepower per hour. The results were thoroughly satisfactory. The gun trials were also carried out while the vessel was at sea, three rounds being fired from each of the large guns, when trained at an angle estimated to impose the most severe test upon the structure of the ship and the gun-mountings. The only effect was the usual breaking of some glass and minor fittings. The trials, which were conducted under the direction of Captain Tanaka and Captain Fujii, with their respective staffs, on behalf of the Japanese Admiralty, were concluded on the 9th inst., after which the vessel returned, to be prepared for commission by Captain Ijichi. It is anticipated that this vessel will leave by the end of May, so that from the date of the laying of the keel until the delivery of the ship only two years and two months will have elapsed—a performance worthy of the high traditions of the company, and four months within the contract time.—*Engineering.*

The Japanese battleship *Katori*, built and equipped by Vickers, Sons and Maxim, Limited, has successfully completed her official trials and is expected to sail for Japan before the end of May. The *Katori* has four 12-inch, four 10-inch, and twelve 6-inch quick-firing guns. During the trials five rounds were fired from one of the 10-inch guns in 2 minutes 8-2/5 seconds. The rate of fire of the 12-inch guns, from which three rounds each were fired, was also found to be high. In some cases, both guns in each barbette were fired simultaneously. Eight rounds were fired from one of the 6-inch guns in 52 seconds. Her full-power trials at her designed mean draft of 27 feet produced a speed of 20.22 knots, while in a 24-hours' test at three-quarters of full power, she averaged 17.8 knots on a coal consumption of 1.6 pound per indicated horsepower per hour.—*Engineer.*

The Japanese Admiralty has introduced a new classification of the fleet, with special reference to the captured ships. There are now nine battleships—the *Iwami* (ex *Orel*), *Sagami* (ex *Peresviet*), *Tango* (ex *Poltava*), *Hizen* (ex *Retvisan*), and *Suo* (ex *Pobieda*), *Mikasa* (still included in the list), *Fuji*, *Shikishima*, and *Asahi*. The *Aso* (ex *Bayan*) is reckoned with the first-class cruisers, the *Tsugaru* (ex *Pallada*) and *Soya* (ex *Varyag*) among the second-class cruisers, and the *Iki* (ex *Nikolai I*) among the first-class coast-defence vessels, while the *Mishima* (ex *Seniavine*) and *Okonoshima* (ex *Apraxine*) are second-class coast-defence vessels. Two of the captured ships are included in the second squadron.—*Army and Navy Gazette.*

PERU.

The protected cruiser *Almirante Grau*, built at Barrow for the Peruvian Government, was launched at Messrs. Vickers' yard March 27, and a sister

vessel is in an advanced stage of construction. Both are to be of high speed (twenty-four knots), and are constructed with a light draft, in order that they may be able to enter all South American harbors. The armament comprises two 6-inch guns, eight 14-pounders, and eight 1¼-pounders, and the cruiser is fitted with submerged torpedo tubes, and has some protection. The length is 370 feet, and the displacement 3200 tons. The engines will have 14,000 collective horsepower. The complement will be 300 officers and men.—*Army and Navy Gazette.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battleships.			
Emperor Paul I.....	16,000	St. Petersburg (Baltic Yard).	Building.
Andrei Pervosvannui.....	16,000	St. Petersburg (Galerney Island).	Launched May, 1906.
Evstafi.....	12,500	Nicolaiev.	Building.
Ivan Zlatoust.....	12,500	Sevastopol.	Launched May 13, 1906.
Armored Cruisers.			
Admiral Makaroff.....	7,200	La Seyne.	Launched May 8, 1906.
Bayan.....	7,200	St. Petersburg	Building.
Pallada.....	7,200	"	"
Rurik.....	15,000	Vickers	"
Protected Cruisers.			
Kagul.....	6,750	Nicolaiev.	Building.

THE NEW RUSSIAN NAVY.—Details are published by the *Neue Freie Presse* of the construction programme which was sanctioned recently for the Russian navy by the Czar, and which is to spread over a term of nine years. The programme comprises twelve battleships, fifteen cruisers, forty-six torpedo-boat destroyers, eighteen torbedo-boats, ten submarines, seven gunboats, nine monitors, and one mining ship—a total of 118 vessels. The distribution of the navy thus to be created is as follows: For the Baltic Sea Fleet.—Nine turret-ships, each of 16,000 to 17,000 tons displacement, with four heavy, fourteen medium, and fifty-six quick-firing guns, armored with nickel steel, 230 millimeters (9 inches) thick, and with a speed of 18.5 knots; four first-class cruisers of 12,000 tons, having a complete belt and protection to the central battery of 135 millimeters (5¼ inches) thick, and carrying forty quick-firing guns—a novel armament owing to the absence of heavy guns; eighteen deep-sea torpedo-boats of 250 to 300 tons; a mining ship of the *Yenissei* type, and ten submarines.

For the Black Sea Fleet.—Three squadron armored ships of 12,500 tons, to replace the old-fashioned turret-ships *Sinope, Ekaterina II,* and *Tchesma,* which date from 1886 to 1887, to be armored and protected in the same way as the other modern armored vessels of the Black Sea fleet, with four guns of 30.5 centimeters (12-inches), four of 20 centimeters (7¾ inches), twelve of 15 centimeters (6 inches), thirty-two small-bore quick-firers, and with 229-millimeter (9-inch) armor, and a maximum speed of 16 knots; seven first-class cruisers, of 12,750 tons; four second-class cruisers of the *Kagul* and *Otchakoff* type, hitherto denominated as first-class, each of 6700 tons displacement, and speed of from 22 to 24 knots; and twenty-eight torpedo-boat destroyers of the *Zwonki* type, 350 tons, and a speed of 26 knots.

For the Far East.—Six coast gunboats, of 800 to 1000 tons, armed with one heavy, two medium, and twelve light guns, and a speed of 14 knots; and nine shallow-draft gunboats, of 250 tons, for the rivers of Northern Siberia.

For the Persian Gulf.—One stationary gunboat.

Cost.—The total cost is calculated at 380,000,000 roubles (38,000,000*l.*), to be divided into nine instalments, to be added each year to the 117,000,000 roubles (11,700,000*l.*) required annually for the normal expenses of the navy. The total naval budget for the next nine years will therefore be 159.2 million roubles (15,920,000*l.*), in which sum is included the cost of equipping and constructing arsenals and docks.—*Nautical Gazette.*

The *Moniteur de la Flotte* gives the following as the estimated dates of completion of Russian warships now building: *Paul I* and *Andrei Pervosvannui*, spring of 1908; *Evstafi* and *Ivan Zlatoust*, spring of 1907; *Rurik* and *Admiral Makaroff*, end of 1907; *Pallada* and *Bayan*, spring of 1908; *Kagul*, spring of 1906. The *Admiral Makaroff*, *Bayan*, and *Pallada* are sister ships like the old *Bayan*. The *Rurik* is an armored cruiser of 15,000 tons, with a battery of four 10-inch, eight 8-inch, and twelve 4.7-inch guns.

UNITED STATES.

VESSELS BUILDING.

No.	Name.	Speed. Knots.	Where Building.	Per cent completed Mar. 1, 1906.
	Battleships.			
13	Virginia	19	Newport News.	99.
14	Nebraska	19	Moran Bros. Co.	90.
15	Georgia	19	Bath Iron Works.	94.6
16	New Jersey	19	Fore River Shipbl'g Co.	97.5
17	Rhode Island	19	Fore River Shipbl'g Co.	100.
18	Connecticut	18	Navy Yard, New York.	96.1
19	Louisiana	18	Newport News.	97.2
20	Vermont	18	Fore River Shipbl'g Co.	76.3
21	Kansas	18	New York S. B. Co.	74.2
22	Minnesota	18	Newport News.	83.5
23	Mississippi	17	Wm. Cramp & Sons.	51.2
24	Idaho	17	Wm. Cramp & Sons.	49.2
25	New Hampshire	18	New York Shipbl'g Co.	39.3
	Armored Cruisers.			
6	California	22	Union Iron Works.	90.
9	South Dakota	22	Union Iron Works.	89.1
10	Tennessee	22	Wm. Cramp & Sons.	94.5
11	Washington	22	New York Shipbl'g Co.	95.5
12	North Carolina	22	Newport News.	37.
13	Montana	22	Newport News.	32.4
	Protected Cruisers.			
10	St. Louis	22	Neafie & Levy Co.	90.6
11	Milwaukee	22	Union Iron Works.	90.9
	Scout Cruisers.			
	Chester		Bath Iron Works	22.2
	Birmingham		Fore River Shipbl'g Co.	24.5
	Salem		Fore River Shipb'g Co.	24.9

The successful completion of the official trials of the new armored cruiser *Tennessee*, which took place on the government course on February 12, marks the addition to the United States navy of one more of a class of ships of which the United States navy is, says the *Scientific American*, very justly proud. The average speed over the whole 80-mile course was 22.15 knots an hour. The *Tennessee* carries as her main armament four 40-caliber 10-inch rifles, whose ability to punish the enemy, even at the more distant ranges, is greater than that of the 12-inch guns mounted on the battleship *Iowa*, for at 5000 yards the 12-inch projectiles of the *Iowa* can theoretically penetrate, if they are capped, 9¾ inches of Krupp armor, whereas the 10-inch projectiles of the *Tennessee* can, under

similar conditions, penetrate 11¾ inches. Moreover, these guns are protected by 9 inches of inclined Krupp armor, which is superior to the 14 inches of vertical turret armor carried by the *Iowa*. In a comparison of the secondary batteries, the *Tennessee* shows a superiority in total energy; since she carries sixteen 50-caliber 6-inch guns, each with a muzzle energy of 5838 foot-tons and protected by 5 inches of Krupp armor, as against eight 8-inch guns of 7500 foot-tons, and six 4-inch guns of about 1000 foot-tons energy, having about the same protection. The total muzzle energy of a single discharge of all the guns of the *Tennessee* amounts to 202,224 foot-tons, whereas the total muzzle energy of a single discharge of all the *Iowa's* guns amounts to only 169,940 foot-tons. Furthermore, the great superiority of speed possessed by the cruiser (22½ knots as against 17 knots) and the higher velocity and flatter trajectory of her projectiles, would enable her to choose a fighting range and bearing with relation to the battleship, which would put the low-velocity guns of the *Iowa* at a disadvantage, and yet enable the *Tennessee* to deliver her fire with telling effect.

The 10-inch guns are mounted in two electrically-controlled, balanced, elliptical turrets, each with an arc of fire of 270 degrees. Four of the 6-inch guns are mounted in independent casemates on the main deck; one at each corner of the central superstructure. The other twelve 6-inch guns are mounted on the gun deck in broadside, and each gun is isolated by splinter bulkheads of nickel-steel from 1 to 2 inches thick. The whole of the 6-inch battery is protected by 5 inches of armor. Four of the 6-inch guns can fire dead ahead and four dead astern. Of the twenty-two 3-inch guns, six are carried in sponsons on the gun deck, six are mounted in broadside on the gun deck, three on each beam in the center of the 6-inch battery, while on the main deck immediately above these and mounted in broadside between the 6-inch gun casemates, are ten 3-inch guns, five on each broadside.—*Page's Weekly.*

ORDNANCE AND GUNNERY, TORPEDOES.

THE BATTLE PRACTICE OF THE BRITISH FLEET.—The results of all the gun practices which were carried out in 1905, including the battle practice, have now been prepared. The following is an abstract of the results of the firings:

Order of Merit.	Battle Practice.				Heavy Gun Layers' Test.			
	Squadron.	No. of Ships	No. of Guns	Average Points	Fleet or Squadron.	No. of Ships	No. of Men Firing	Points per Man
1	Channel.....	12	182	157·0	Atlantic.....	15	211	76·01
2	3rd Cruiser...	4	56	147·9	3rd Cruiser...	4	52	75·43
3	Mediterranean	12	177	133·1	Channel.....	14	188	74·64
4	Atlantic.....	11	176	91·8	2nd Cruiser...	6	78	69·05
5	China.....	8	112	65·3	Mediterranean	12	147	68·54
6	2nd Cruiser...	6	88	54·0	East Indies...	5	43	66·66
7	1st Cruiser...	6	76	47·5	China.....	14	162	65·05
8	Australia.....	1	14	46·8	Cape of Good Hope.....	4	38	64·14
9	East Indies...	4	37	37·6	1st Cruiser...	6	72	61·63
10	Cape of Good Hope	4	39	31·6	Australia.....	5	47	55·37
11					N. A. and West Indies.....	4	36	53·04
12					Tenders.....	11	22	26·12
		68	957	120·0		100	1096	68·36

LIGHT QUICK-FIRING GUN LAYERS' TEST.

Order of Merit.	12-Pounders.				6 and 3 Pounders.			
	Squadron.	No. of Ships	No. of Men Firing	Points per Man	Squadron.	No. of Ships	No. of Men Firing	Points per Man
1	East Indies...	1	8	48·92	3rd Cruiser...	5	37	23·98
2	Channel.....	7	78	33·64	Atlantic.....	10	103	23·85
3	Australia.....	2	20	31·65	Australia.....	5	29	21·18
4	Mediterranean	11	152	24·53	Channel.....	9	60	20·31
5	3rd Cruiser...	4	38	24·52	East Indies...	6	43	20·18
6	1st Cruiser...	3	28	23·84	Mediterranean	11	66	19·94
7	Atlantic.....	9	114	21·10	1st Cruiser...	6	69	19·03
8	2nd Cruiser...	6	52	20·14	N. A. and West Indies.....	1	8	18·28
9	China.....	3	36	15·99	2nd Cruiser...	6	18	16·79
10					Cape of Good Hope	4	44	16·18
11					China.....	9	51	13·00
12					Tenders	13	52	12·75
		46	526	24·73		85	580	19·25

—*London Times.*

NAVAL 6-INCH GUNS OBSOLETE.—A number of naval 6-inch guns have been handed over to the British military authorities as of no further use for naval purposes.—*Engineer.*

An article in *Le Yacht* discusses the effect of torpedoes on the Russian ships at Tsushima and calls attention to the necessity of increasing the weight of their explosive charge if they are to be considered truly effective against modern battleships.

THE NEW VICKERS-MAXIM 12-INCH BREECH-LOADING WIRE-WOUND GUN.—The new type of 12-inch breech-loading wire-wound gun made by Vickers-Maxim possesses several improvements, notably in the breech operating gear. This gun, which will figure largely in the new cruisers and battleships now being built for the British navy, has a total length of 556.5 inches, which is equivalent to 46.375 calibers, the length of the bore being 540 inches, or 45 calibers, while the shot has a travel of 459 inches, or 38.25 calibers, the length of the projectile chamber thus being 81 inches. At the breech the diameter of the weapon is 5 feet 6 inches, and at the muzzle behind the swell 1 foot 10 inches. The wiring jacket ranges from 80 wires at the breech through gradual reduction to 16 wires at the muzzle. The weapon fires a projectile of 850 pounds with a charge of 310 pounds. The muzzle velocity is 2850 foot-seconds, and the muzzle energy 47,874 foot-tons. The powder pressures within the bore of the gun vary from a maximum of 18 tons to the square inch against a circumferential strength of 34.4 tons per square inch at the breech to 7.65 tons to the square inch against a circumferential strength of 16.1 tons to the square inch at the muzzle.

This weapon is considerably larger and more powerful than the latest type of 12-inch 50-ton wire-wound gun produced at the British government arsenal at Woolwich. This Mark IX class is five calibers shorter than the new Vickers' production, being only 496.5 inches in length—41.375

calibers—yet the longer weapon is considerably stronger, especially toward the muzzle.

The breech operating mechanism for this latest Vickers' 12-inch gun is of a new type, containing several distinctive improvements, whereby a considerable increase in power is obtained when closing the breech. The mechanism is operated by a hand wheel with worm and worm-wheel gear mounted in a bracket carried on the end frame of the gun, and the gearing is so arranged that to operate the mechanism completely seventeen turns are necessary—12.2 turns to unlock the breech and 4.8 turns to swing it out to fully open position. The Vickers' type of breech screw is used, mounted and retained on the stem of the carrier by interrupted screw threads.

In this mechanism a pure "couple" for rotating the breech screw is applied, and the inherent defect of the general type of breech mechanism, wherein the screw is rotated by a turning movement which sets up appreciable friction, due to a tendency to produce axial displacement of the breech screw, is obviated. By the utilization of a couple, the whole of the available turning force applied to the breech screw is employed in seating the obturator, and all possibility of friction from the above-mentioned tendency is completely overcome.

The breech-block carries the Welin screw in which the thread is cut in successive steps of decreasing radii. In unlocking the breech it is necessary to rotate it only through as much of arc as equals the length of one step of the thread. This disengages all the threads so that the block can be withdrawn. The advantage of this type is that a minimum amount of the thread has to be cut away, and the breech-block can be proportionately reduced in length and weight. There are two sets of safety slides, one for percussion lock and the other for the electric lock, fitted to the box slide. On opening the breech the percussion striker is automatically fully cocked. A floating needle is arranged so that normally the point of the needle is always within the face of the lock frame. The electric lock is of special design, there being two levers, one on each side of the lock frame, and these are simultaneously operated on the first movement of the lock frame on opening the breech. The arrangement of these two levers is such that there is a small projection round their bosses which trips against the lock slides on the box slides. As the outer ends of these levers act directly on the electric needle, the latter is drawn away almost instantaneously from the lever on the first movement of the unlocking of the breech.

In the event of a miss-fire the lock frame can be drawn away sufficiently to eject the primer without opening the breech, owing to the arrangement of the spring bolts engaging the lock frame with the slide link in the carrier, and the engagement of the slide with the operating cam on the crank.

The extractor is of special design upon new lines. It is of great strength and is made in two parts. The operation of the lock frame acting, because of a fine incline on the first part of the extractor which is the toe, first powerfully wedges out the primer before its rapid ejection by the engagement of the second part of the device which is comprised by the lock of the extractor.

The complete weight of the weapon exclusive of the carriage is 57 tons 8 hundredweight 2 quarters 16 pounds. Its penetrative capacity with capped shot so far as has been ascertained is 24.3 inches through Krupp cemented plate. Further tests with the weapon are, however, to be carried out, when definite data on the point of penetration will be available. —*Scientific American.*

Danzer's *Armee Zeitung* recently devoted an article to the German '98 rifle with the "S" ammunition, which has added greatly to the power of the weapon by giving to the projectile a much flatter trajectory. The bullet is lighter than its predecessor, and its balance is different in its

flight, but the *Armee Zeitung* states that any disadvantage is believed to be overcome by an improved explosive. The *Armee Zeitung* shows that the German rifle with the "S" bullet presents advantage over the Austrian '95 rifle. The point upon which insistence is placed is the flatter trajectory and increased width of the danger zone. Moreover, the added velocity of the new bullet gives it greater penetrating power. The Austrian bullet, at a distance of 100 paces, will penetrate 31.5 inches of dry fir wood, and 22 inches of dry oak, while the "S" bullet at 40 meters, will perforate 31.5 inches of fir wood, and at 800 meters 4 inches of the same. Some other particulars are given by the *Armee Zeitung*, and the general conclusion is that, if the new German ammunition has the qualities ascribed to it, it presents many advantages over the American weapon and ammunition.

The *France Militaire* gives some account of the French D bullet, the *petit bijou* concerning which some statements have appeared in the press, and we read that it is such a charming morsel that it might be delightful to be killed by it rather than by a vulgar bit of lead. The essential property of the new projectile is, like that of the German bullet, that it has a much flatter trajectory owing to the great increase in the initial velocity. Our contemporary will not give the figures of this velocity, because they are regarded as confidential, but it says that the zone within which a man standing erect would be in danger has been increased to 600 meters. The new ball is of biogival form, very pointed, and apparently much longer than the 1886 M bullet, which is of lead, with a hard mantle, while the D ball is of copper and lighter than the leaden bullet. The velocity is better maintained than in the case of the old projectile, and the *France Militaire* says that it is far from being proved that the S bullet has a flatter trajectory than the D, as the Germans assert. The full range of the D bullet is not stated, but it is probable that it is near 3600 or 3800 meters, although it is not asserted that at the extreme range it would be likely to cause any serious damage.—*Army and Navy Gazette.*

THE NEW GERMAN RIFLE BULLET.—Two of the most important properties which a military rifle can possess are great ranging power and a flat trajectory.

These properties depend mainly on two factors, high muzzle velocity and high sectional density, *i. e.*, a high ratio between weight and cross-section of bullet. A third factor is the shape of the bullet, more particularly the shape of the head, by which the resistance of the air is considerably modified.

Considerations of recoil, weight of rifle, etc., make a heavy bullet incompatible with high muzzle velocity, and in order to keep the sectional density as high as possible, it has been found necessary, as the evolution of the rifle has progressed, to reduce the diameter of the bullet as well as to reduce its weight. In modern military rifles the diameter of the bullet varies between 0.32 and 0.26 inch, the corresponding weight of bullet being from 244 to 163 grains.

The German military authorities have been experimenting for some time past with a view to increase the muzzle velocity of their rifle to approximately 3000 feet per second, in order to insure the flattest possible trajectory at decisive ranges, a consideration which they regard as of primary importance.

There were obvious objections to doing this by reducing the caliber of their rifle from 0.311 to 0.256 (or some smaller caliber) which would be the first method to suggest itself. Apart from the great cost involved in such a change, there are certain objections to a very small bore, *per se*, viz., diminished wounding power and increased difficulty of cleaning and keeping in order the interior of the barrels.

The alternative solution was to improve the ballistics of the existing rifle by a suitable modification of its ammunition, and it appears, from a recent article in the *Kriegstechnische Zeitschrift* (1905, Heft 9), that this has been effected partly by the adoption of a more powerful charge (whether a new powder is involved is not quite clear) but mainly by the adoption of a new bullet, known, on account of its pointed shape, as the Spitze-geschoss or "S" bullet.

This bullet weighs only 154.3 grains as against the 227 grains of its predecessor, or as against the 215 grains of our Lee-Enfield bullet.

This reduction of 73 grains weight, coupled with the higher pressure given by the new charge, has apparently raised the muzzle velocity of the German Mauser from about 2090 f. s. to about 2900 f. s.

An additional and by no means unimportant advantage secured by the reduction in weight of the bullet is that about 15 per cent more ammunition can be carried than heretofore.

It will be seen that in designing their new bullet the Germans have deliberately departed from the principle, hitherto considered essential, of a high sectional density.

Assuming, however, the correctness of the published data, it is evident that this low sectional density has been compensated for by the altered shape of the new German bullet, which gives rise to a very much lower air resistance than has hitherto been considered possible at normal atmospheric temperature and pressure.

The importance of the alteration in form may be gauged by the fact that had the normal shape been retained, the remaining velocity of the bullet at about 1000 yards would have been no greater than that of our bullet, which starts at 800 f. s. lower velocity, while beyond 100 yards the heavier bullet would have travelled faster.

As it is, the "S" bullet maintains its superiority in velocity at practically all ranges. Whether it compares favorably with the heavier bullet in accuracy is, however, doubtful.

The greatest advantage given by the "S" bullet in the matter of flatness of trajectory is to be found between 500 and 800 yards. At 700 yards range a man 5 feet 9 inches in height would be hit anywhere along the range if the muzzle of the rifle were 12 inches from the ground, the sights set at 700 yards, and the ground line aimed at. The same effect would only be produced with our present service rifle at about 550 yards.

Without experimental data it is difficult to estimate exactly the energy of recoil of a 9-pound rifle with a muzzle velocity of 2900 f. s. and a 154-grain bullet, but it would appear to be well below the limit of 15 foot-pounds, which is the maximum desirable in a military rifle.

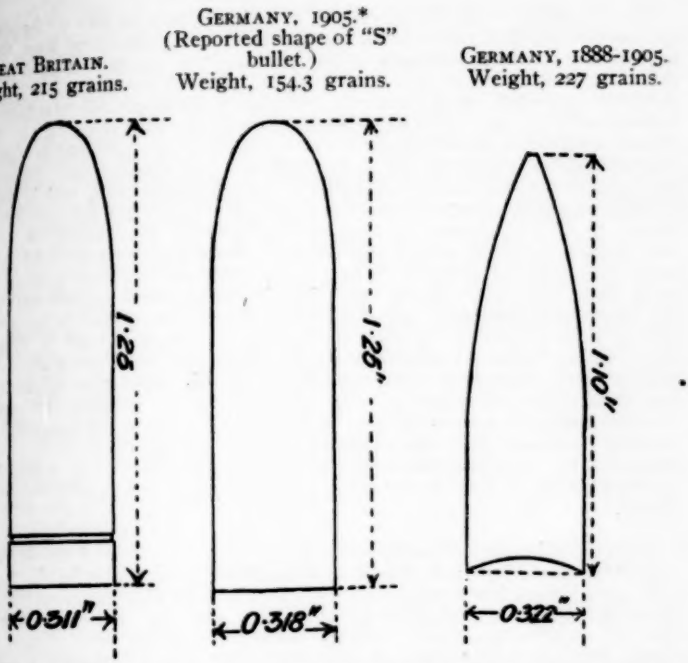
Two further questions affecting the military value of the new bullet arise: its wounding power, and its penetration.

Taking the striking energy of the bullet as the measure of its wounding power, it would seem that the new bullet is more effective than the Lee-Enfield up to between 900 and 1000 yards; beyond that range it is slightly inferior, but the difference is not marked.

Apart from its superior striking energy, however, the so-called explosive effect characteristic of modern high-velocity bullets at close ranges would probably be occasioned by the "S" bullet at very much greater ranges than is at present the case; possibly up to 600 or 700 yards, as against 200 or 300 with the present bullet. Experiments, however, would be necessary to test this point.

As regards penetration, the advantage must lie with the new bullet at all except extreme ranges.

Diagrams of the new and old German bullets, and of our 0.303 bullet follow.



All three bullets have lead cores, the British bullet having a cupro-nickel jacket, the jackets of the two German bullets being of nickel-plated steel.

WIRELESS TELEGRAPHY.

REGULATION OF WIRELESS.—The cruise of the *Dewey* floating dock across the Atlantic gave opportunity for some very valuable practice in long-distance wireless telegraphy, messages from the guardians of that huge but not speedy craft having been received over something like 1800 miles. These records were made, of course, under the favoring shelter of night, like practically all the other long-distance records. This is very encouraging, albeit it chances to be coupled with home news of a somewhat amusing character, when some high school boys of an experimental turn of mind threw the Newport naval wireless station into a succession of fits with an old Morse key, a broken incandescent lamp, and a few dry batteries. These youngsters had the commendable Yankee spirit and no desire to make trouble for their country's defenders. They gave incidentally a valuable demonstration of the need of improvement, to which we trust the Navy Department will give due heed. If such rudimentary equipment accomplished so considerable a disturbance, what would happen if a hostile fleet went deliberately to work with powerful and skilfully devised apparatus? Of course, in working disturbance at a distance, much more power is needed than when working nearby. Still it appears safe to conclude that the navy system as now used could be hopelessly tangled up, without going to much trouble. And the same so far as has yet transpired is true of every other wireless system in use for practical purposes. Where is the syntonic wireless of which we have heard so often enthusiastic reports?

*Kriegstechnische Zeitschrift, Heft 10, p. 607.

Of course, for long-distance work everybody likes to use as long waves as practicable, and there being limits on the feasible lengths of vertical antennæ, the natural tendency is for all hands to use waves of about the same order of magnitude. The work of these Newport boys, however, signifies that with the apparatus now commonly used one can get interference with almost any sort of sending wave provided it carries a reasonable amount of energy. If there is any such thing as a syntonic system, it is high time Uncle Sam hunted it up with a view to adoption. There have been many very ingenious schemes of syntonism proposed, and if any one of them is really effective his owner should pack up his kit and head for Newport. His welcome is already guaranteed. Meanwhile, it is time something were done in the way of preventing malicious or improper use of private wireless stations. There is no need of interfering with legitimate experimenting. These boys with extemporized outfits may some day help the government out of a scrape, but means should be provided to confine their efforts within definite bounds, just as it would be proper to check indiscriminate trials of searchlights in the neighborhood of lighthouses. The rights of the government in the regulation of commerce would seem to be sufficient to cover the case, if judiciously exercised. Perhaps as good a way as any would be to require the registration of wireless stations, without expense, and their operation under permits revocable for persistent misuse or other sufficient cause. It would be an excellent thing for the government thus to keep in touch with.—*Electrical World.*

DIRECTED WIRELESS TELEGRAPHY.—At a recent meeting of the Royal Society (London) Dr J. A. Fleming communicated a paper by G. Marconi dealing with methods whereby the radiation of electric waves may be confined mainly to certain directions, and whereby the receptivity of a receiver may be restricted to electric waves emanating from certain directions. For the usual vertical antennæ there was substituted a straight horizontal conductor placed at a comparatively small distance above the surface of the ground or water. In some of the tests the transmitting conductors consisted of horizontal wires, the radiations being received at a distance by means of the usual vertical wires suitably attuned. In other tests both the transmitting and the receiving conductors consisted of horizontal wires, while in additional tests the transmitting conductors were vertical and the receiving conductors horizontal. In each case the signals were inaudible when the horizontal conductor was placed at right angles to a line joining the transmitting and receiving stations, and they reached a maximum when the horizontal conductor was placed directly in this line.—*Electrical World.*

DEVELOPMENT OF WIRELESS TELEGRAPHY.—Some interesting data were given as to the growth of wireless telegraphy by Mr. John Bottomley to the Marconi stockholders at their annual meeting. During the twelve months ending January 31, 15,076 messages, comprising 203,276 words, were sent and received by the American company alone and through its ship and shore stations. During the same period, 1904-1905, 8314 messages, containing 122,424 words, were sent and received. These figures do not include the operations of the stations controlled by the English, Belgian, French, Canadian, and Italian allied companies.

The completion of the new station at Sea Gate in January last gives an unbroken chain of stations owned and controlled by the Marconi system from New York harbor to Cape Race, N. F., by means of which vessels entering or leaving New York harbor are in constant communication day and night for about seventy hours. Thus, a vessel outgoing, on leaving her dock, takes up Sea Gate, carries this station until communication is established with Babylon, carries Babylon to Sagaponack, Sagaponack to Nantucket, Nantucket to Sable Island, Sable Island to Cape Race.

Each of these stations is connected with the land lines so that messages are sent to or received from every part of the United States, Canada, and, indeed, the world.

The long-distance station at Cape Cod has transmitted and received many messages across the ocean without any relay whatsoever. News and commercial messages are constantly transmitted from this station to vessels, 1700 miles away. At present out of about 70 vessels trading regularly across the Atlantic, which are equipped with Marconi instruments, thirteen are fitted with long-distance receiving apparatus. It is predicted that in a very short time these vessels will be in constant communication with land during the entire trip across the ocean.

Mr. Bottomley referred to the success which Mr. Marconi has had in transmitting wireless telegraph signals in a predetermined direction. Recently at Clifden, Connemara, a horizontal wire 230 meters in length was laid on the ground and connected at one end to a magnetic detector and to earth. With this wire is was possible to receive with clearness all the signals transmitted from the Poldhu station (about 300 miles away), provided that the free end of the conductor pointed directly away from Poldhu. No signals could be received if the horizontal wire made an angle of more than 36 degrees with the line of direction of Poldhu. Other important tests were carried out with the co-operation of His Majesty's ship *Furious*. At Poldhu eight horizontal wires 60 meters in length were disposed radially at about two meters above the ground. By means of a switch any one of these wires, which divided a circle into eight equal parts, could be connected to a magnetic receiver.

The *Furious*, which was fitted with the usual vertical aerial, followed a course describing an arc of about 180 degrees round Poldhu, at distances up to sixteen miles. By means of a horizontal wire arrangement the bearing of the ship from Poldhu could be determined at any time by noting on which particular wire or wires the reception of signals was strongest, and also by observing which wires were non-receptive. It was also found possible to receive simultaneously, and without mutual interference, different signals sent by means of oscillations of the same wave length coming from the ship and from the Lizard wireless station whenever the position of the ship was such that a line drawn from it to Poldhu made an angle of at least 50 degrees with the bearing of the Lizard station.—*Electrical World.*

DIRECTED WIRELESS TELEGRAPH MESSAGES.—The transmission and reception of two or more wireless telegraph messages simultaneously in the same zone of action, or selectively, as it is called, is a problem second only in its abstruseness to the telephonic relay, that scientific will-o'-the-wisp over which inventors have struggled ever since Bell devised his apparatus to send and receive articulate speech over wires.

Many solutions, electrical, mechanical, and electro-mechanical, have been provided to secure selectivity, but at the end of a decade of wireless telegraphy it seems that all the labor expended in this direction has been virtually in vain, in so far as the coveted goal is concerned, though through the researches in electrical resonance excellent results have been achieved in tuning and syntonization, which important factors are largely accountable for the present degree of advancement in long-distance wireless signalling.

Since it is sometimes more convenient to enter a window than to go through a door, many inventors have ceased trying, at least for the time, to discover the "open sesame" of selectivity, and have confined their efforts to the easier task of directing, within certain limits, the wireless waves. Artom, of Italy, was the first to evolve such an arrangement and attain favorable results; this he did by means of circularly polarized electrical radiations, which he produced without resorting to reflection grids, as is necessary in the case of light waves.

Much simpler than this Italian physicist's method is one recently made public by Marconi, while the experiments of the latter indicate that a wider range of usefulness will be given the previously inflexible wireless transmitter and receptor than has yet been known. Briefly, the scheme is this: When one end of an insulated horizontal wire (the other end of which is free) is connected to one side of a spark gap of an induction coil, and the other side of the gap is earthed, the electric waves emitted by the wire will reach a maximum in the vertical plane of the horizontal wire, and proceed principally from the end connected to the spark gap, the radiation being imperceptible in any other direction approximating 100 degrees from that in which the maximum effect takes place.

Similarly, if an insulated conductor is laid on the ground, or placed a short distance above it, and the end nearest the sending station is connected to one side of an electric wave detector, the other side of which is earthed—leaving the opposite terminal of the wire free—the maximum effect will be evident only when the receiving and transmitting wires are in alignment with each other. Marconi further points out that if the receiving horizontal wire is so arranged that it can be turned in a circle about its earthed end in a horizontal plane, the maximum and minimum effects observed during the process of swiveling will enable an operator to easily determine the direction of any transmitting station within the field of radiation.

A number of trials were conducted to ascertain the best lengths of the horizontal wires for both transmission and reception, the distance these wires should be elevated from the earth, and finally the greatest distance obtainable between stations thus equipped. The experiments were further varied by employing the regulation aerial wire for sending, the complementary apparatus using the horizontal wire.

The whole series of tests cannot here be cited in detail, yet the following will suffice to show in a measure the results secured. In one of the experiments the transmitter, having a spark length of about 2 cm. (¾ inch), was connected to a horizontal conductor 656 feet in length, supported at a height of 49¼ feet above the ground; the receptor was furnished with a wire of equal length 3¼ feet above the ground, and connected to one end of a magnetic receptor. Now, when the horizontal wires of both stations were in line, so that the maximum effects were obtainable, easily-read signals were heard at a distance of 25 km. (15½ miles). When the receiving wire was swung around to 12 degrees, nothing could be heard even when the receptor was moved to within 12 km. (7½ miles) of the transmitter; and when placed within 5 km. (3.1 miles), the angles of the wires remaining unchanged, only weak signals were indicated.

In another trial the great Poldhu station with its vertical aerial was used for sending, and a receptor placed at Clifden, Ireland, 500 km. (310 miles) away, was provided with a horizontal conductor 754.6 feet in length, laid on the ground, and connected to one side of a magnetic receptor, the opposite side being grounded as previously explained. When the free end of the receiving wire pointed directly away from Poldhu, the signals were sharp and loud; but when the horizontal wire made an angle of more than 35 degrees with the line of Poldhu, the reception was absolutely *nil*.

In all of his experiments where the tests were made over considerable distances, Marconi employed his magnetic receptor; but where the distances were short, he utilized a Duddell thermo-galvanometer, since this delicate instrument permitted him to measure the current values of the electric oscillations set up in the receiving wires.

The horizontal wire, if it is proven to be anywhere nearly as effective as the usual aerial wire, will greatly reduce the expense of wireless telegraph installations, for the masts often cost as much or more than the instruments. The new arrangement will do much to further the commercial possibilities of this mode of transmitting intelligence if the mast can

be eliminated, and the whole series of tests points to a new era of wireless telegraphy.

One of the noteworthy observations made by Marconi was that electric currents set up by distant atmospheric conditions can not only be detected, but the direction whence they originate determined; and this may mean that a new instrument is to be placed in the hands of the meteorologist. There are other aspects of the experiments which will be looked forward to with interest.

In the army and navy wireless telegraphy has proven an invaluable aid, and this has been due chiefly to the fact that messages could be sent and received over long distances, while the direction whence they came or whither they went was an impenetrable mystery to the enemy. Now all this is changed, and some extraordinary complications may be looked for. As a palpable problem it is a duplication of heavier armor plate, heavier guns; heavier guns, heavier armor plate, and so on to infinity.—*Scientific American.*

MISCELLANEOUS.

COAL IMPROVED BY STORAGE IN THE SEA.—Important experiments have been carried on by the naval authorities at Portsmouth, England, for some time, to ascertain the extent of the steaming properties of fresh coal, which has been improved by storage in the sea. Eighteen months ago iron crates, each containing two tons of coal, were sunk in a big basin in the dockyard. At the same time a similar quantity of coal was carefully stored in the open air at a coaling point and sheltered by tarpaulins. At intervals of six months, two-ton samples of exact storage have been taken and carefully burned. The results have shown conclusively, that by the submarine storage of coal its calorific value steadily increases, while by storage in the open air a decided decrease is shown. At naval stations in the tropics the decrease in calorific value is very great, the heat of the sun extracting the light, volatile oils.

The Admiralty is satisfied with the physical and financial advantages of submarine storage, and has now directed that experiments be made to ascertain its practicability on a large scale. The difficulty is that submerged coal must be dried before it is used or otherwise the superficial moisture would soon cause spontaneous combustion. Close confinement in the bunkers of warships is the only method of drying heretofore attempted. Spreading quantities of thousands of tons in the open air has not been feasible.—*American Manufacturer.*

NEW CUNARD LINERS MAURITANIA AND THE LUSITANIA.—The two new Cunard liners which are being built with the $13,000,000 lent by the British Government are fast nearing completion and will be launched in June or July of this year. They will be named the *Mauritania* and the *Lusitania* and will be the largest ships the world has ever seen.

Some remarkable figures regarding the two vessels are supplied by the Cunard company. Each vessel will have a gross tonnage of 33,200, while they are 60 feet longer than any other liner afloat. They are 88 feet beam, and in this respect are the first to surpass the *Great Eastern*, which was 83 feet in breadth. They will each have accommodations for 3000 passengers and carry a crew of 800. They will be propelled by turbine engines, capable of developing 80,000 horsepower, in each ship, and are expected to travel at a minimum speed of 24 knots an hour.

Marine engineers predict that the two vessels will be the steadiest ships on the ocean. They will be fitted in a manner equal to the most gorgeous modern hotels. The decorations will consist of reproductions of the greatest works of art, while the system of elevators between the various decks will provide for the rapid transit of the passengers from one part of the ship to another.

The first-class dining saloon will be unprecedented in marine architecture. It will be a massive and gorgeous apartment 125 feet long and 80 feet wide and will comfortably accommodate 500 persons at one meal time. The saloon will be lighted by a great dome extending up through the two decks and crowned with a roof of cathedral glass.

More than one engineering record has been broken in the construction of these ships. The stern frames and brackets are the largest ever known, the former alone weighing 47 tons and requiring no fewer than 69 tons of molten metal in the making. The rudder weighs 79 tons, and each link in the 2000 cables is 22¼ inches long and weighs 160 pounds. Each link was tested and withstood a strain of 370 tons.—*Nautical Gazette.*

THE ECONOMY OF MARINE STEAM TURBINES.—An interesting proof of the growing belief in the economy of steam turbines is afforded by the guarantees offered by various builders in connection with the construction of a fast mail steamer for the Roumanian State Railway service with Constantinople and Alexandria. This vessel, of 360 feet in length, 43 feet beam, and 26 feet 6 inches depth, is to carry a dead-weight load of 1500 tons on a draft of 18 feet, and is to steam 18 knots with twin-screw triple-expansion engines, developing 7000 indicated horsepower. One or two of the European firms submitted alternative designs, with the Parsons steam-turbines driving three shafts and three screws; and they guaranteed that, in attaining a speed of 18 knots with the load already indicated, the coal consumption should not exceed 7716 pounds per hour. As the turbines would be lighter, the displacement of the ship would be lower, and less power would be required to attain the contract speed. But what the shipowner is concerned with is the expense involved for a given duty, and, consequently, the consumption per hour appeals to him as readily as any other standard.

In the case of the reciprocating engines it was stipulated that the consumption should not exceed 1.543 pound per indicated horsepower per hour, which works out, for the 7000 horsepower required for 18 knots, at 10,801 pounds per hour. This rate for reciprocating engines is by no means high. The turbine machinery therefore requires 3000 pounds less coal per hour, a saving on the fuel consumption for reciprocating engines of something like 30 per cent. Strict penalties were specified in connection with all the results. In the event of an excess of consumption, the penalty is to be $200 for each 1 per cent over the rate stipulated (1.543 pound per indicated horsepower per hour), and if the rate exceeds 1.85 pound, the vessel may be rejected. Any diminution of speed is to involve a fine in the proportion of $16,000 per nautical mile; and if the speed should be less than 17½ knots, the vessel may be rejected. In respect to power, an excess of 3 per cent is permitted, but for each horsepower over this a penalty of $60 is to be exacted, and the vessel may be rejected if the rate exceeds 7500 indicated horsepower. Under these conditions the guarantors of a rate of consumption for turbine machinery must fully realize that they are able to implement their promise.

The tenders for this vessel were opened in public, and the amounts at once announced. A French company, the Chantiers Loire—no doubt due to the large shipbuilding bounty which is payable even on vessels built for foreign powers—submitted the lowest tender, $459,000, and promised delivery in 12½ months. The next lowest tender was that of William Beardmore & Co., Limited, of Glasgow, who asked $500,000, but promised delivery in 12 months, the shortest time offered by any of the firms. Next came the Vickers Co., with the price $10,000 higher. Then followed Burmeister & Wain, of Copenhagen, and the Chantiers Penhöet, of St. Lazare, each of whom asked $530,000, and 14 months' time. The Fairfield Co., of Glasgow, submitted alternative designs; and asked $537,875 and $559,635, with 14 months for delivery. The other firms ranging up to

$730,000, an Italian concern being the highest. The German companies were something like 25 per cent above the lowest.—*Nautical Gazette.*

THE GERMAN SUBMARINE CABLE NETWORK.—A very interesting review is presented by U. S. Consul Liefield, of Freiburg, Germany, on the development of the German submarine cable system. He calls attention to the significant fact that the new cable from Yap, in the Caroline group, to Shanghai, furnishes the final link in the first non-British cable to encircle the globe. He gives also the following data:

The year 1905 has been for the German cable industry a very significant one, for it not only gave to Germany a great many new cables, but the advantages and advancements made in sea cable technic can be said to have been in every respect first-class. It is claimed that the rapidity and precision with which the newest German cable from Shanghai to Yap, in the Caroline Islands, was laid, which had been finished and ready for use on November 1, are unexcelled.

The number of German cables which have a length of over 62 miles has been increased through this new cable to thirteen and are as follows: Emden-Borkum-Lowestoft (England) (1871), 261.5 miles; Hoyer-Westerland-Arendal (Norway) (1879), 293.3; Emden-Valentia (Island) (1882), 984.8; Emden-Borkum-Vigo (Spain) (1894-96), 1304.2; Sassnitz-Trelleborg (Sweden) (1898), 72.7; Emden-Borkum-Horta (Azores) New York (1900), 4790.1; Tjintau-Tschifu (China) (1900), 283.9; Tsintau-Shanghai (China) (1900), 436.2; Emden-Borkum-Bacton (England) (1901), 288.9; Emden-Borkum-Horta (Azores) New York (1903), 4911.9; Koustanza (Roumania) Constantinople (1905), 213.1; Menado (Celebes) Yap (Caroline) Guam (Ladrones) (1905), 2018.8; Shanghai-Yap (Caroline) (1905), 2229.4.

Of these the Emden-Valentia and Emden-Borkum-Horta belong in common to Germany and England; Sassnitz-Trelleborg in common to Germany and Sweden, Emden-Borkum-Vigo and Emden-Borkum-Horta to the German Atlantic Company; Koustanza, to the East European Company; Menado-Yap and Shanghai-Yap to the German-Netherlands Company, and only the remainder can be considered as the sole property of the German Empire. The Emden-Valentia was formerly the only telegraphic communication with America, but ceased to be used when the real German Atlantic cables, Emden-Borkum-Horta and Tjintau-Tschifu, were completed. Besides these large ocean cables there are a great number of shorter ones which are partly in use between the various German seaports, and between Germany and neighboring countries. For example, there is a cable 51.57 miles long from Arkona to Trelleborg, Sweden, which has been in use since 1865, and besides these there are three African cables which have been rented from the owners, the different English cable companies. These are as follows: East Africa, Sansibar-Bagamoya-Dar-es-Salaam, 84.5 miles; Southwest Africa, Swakopmund-Mossamedes, 152.8 miles; Kameron, Boony-Duala of 209.4 miles. Of these, the first two belong to the Eastern and South African Telegraph Company, and the last to the African Direct Telegraph Company.

Altogether Germany has over 18,816 miles of cables, of which, however, only about 3293 miles are owned by the government. The total cable length of the earth is between 273,402 and 279,616 miles, from which will be seen that Germany's percentage is, notwithstanding all the progress which had been made in the last year in that direction, very modest. Really, only about one-fifteenth of the total cable length is German, while England has more than two-thirds. Not more than two years ago, however, Germany's part was no more than one-twentieth, so it is evident that since that time Germany has made great strides forward.

From Europe to East Asia and to the Chinese coast there are the land telegraphs and sea cables of the Danish Great Norse Telegraph Company. The Atlantic Ocean is traversed not only by the English telegraph lines

but also by the American, French, and German cables. These are, through the various service lines of the United States, combined with the western coast of America, and from San Francisco the American Pacific cable extends via Guam to the Philippines. In Guam, however, the German-Netherlands cable system branches off to Yap, from which place the new cable has made a new bond of union with the German and Danish lines on the Chinese coast. The cable Shanghai-Yap assures to Germany henceforth a telegraphic union with the Ladrone and Caroline islands independent of English influence, and these islands are German colonial possessions, besides also the union with the Great Sunda Islands and the important Dutch colonial possessions in Farther India, which are so important also for the German commerce.

The Shanghai-Yap cable line has been laid in greater sea depths than any other cable. Up to a few years ago there was no cable in a greater ocean depth than 16,404 feet. The American cable in the Pacific Ocean was in 1903 laid in depths to 20,469 feet. The cable Menado-Yap-Guam, which was laid in the year 1905 by the German cable steamer *Stephan*, surpassed this record, inasmuch as it was obliged to lay the cable in depths of 22,966 feet, and to lay the cable Shanghai-Yap, which work was also the task of the cable steamer *Stephan*, it was even necessary in the vicinity of Liukiu Islands to reach depths of 26,246.96 feet, which is one of the deepest places to be found anywhere in the oceans. The cable was manufactured in Germany by the North German Sea-Cable Works in Nordenham at the mouth of the Weser.—*Electric World.*

AN INTERESTING IRON FLOATING DOCK.—There recently left the stocks at Tsingtau, China, an iron coffer or floating dock capable of lifting the biggest battleship in the world, its bearing capacity being no less than 16,000 tons. Due to the enormous dimensions of the dock in question, necessitated by its high bearing capacity, it ranks as one of the largest of its kind in the world. This dock, which has taken two years to construct, was built for the German Government by the "Gutehoffnungshütte," of Oberhausen. The total weight of the construction is 8800 tons. The dock was launched complete ready for operation.

The dock consists of five detachable bottom pontoons with superimposed lateral chambers or boxes by means of which the pontoons can be rigidly attached to each other. The entire dock has a length of 410 feet with a width of 128 feet. The height of the pontoon on the center is 19 feet, while the lateral boxes or sidewalls are 43 feet high, so that the total height of the dock amounts to 62 feet, in round figures. Each pontoon has a length of 80 feet, and is divided into eight watertight cells by means of three longitudinal bulkheads and one main framing. The water ballast is pumped out of these cells by means of ten horizontal centrifugal pumps, two of which are located in each pontoon; they are actuated by electric motors coupled direct to the pump rods. The starting and stopping of these motors, and the control of the slide valves required for the pumping plant, is effected by the aid of electricity from a controlling station located upon the lateral boxes. The electric current is supplied from a central station situated on the land. By means of all these devices the dock, with the vessel lying therein, can be raised within a period of two hours. In addition to the three bulkheads mentioned above, each pontoon has 28 transverse framings which serve as stays. The lateral boxes or chambers are also strengthened by bulkheads and frames, which are located directly above the transverse stays of the pontoon.—*International Marine Engineering.*

NEW DOCK AT GIBRALTAR.—The third and largest of the three new docks at Gibraltar was recently opened without ceremony and the cruisers *Arrogant* and *Amethyst* were docked in it. With the exception of a few minor details, Gibraltar dockyard is now nearly completed. It has three

large docks, numerous workshops, the latest plant, and an enclosed protected harbor capable of anchoring the combined Mediterranean and Atlantic fleets.—*Page's Weekly.*

A NEW LAKE SUBMARINE.—The submersible torpedo-boat *Lake* has been launched at Newport News and appears to be a very powerful craft, supposed to be capable of crossing the ocean with her own engines. The armament is three torpedo tubes. The boat is submerged by sinking on an even keel and running at any desired constant depth parallel to the surface by means of a system of rudders, a great reserve of buoyancy, and great longitudinal stability. There is a large and high conning-tower, and a wide and high superstructure in which the gasoline is to be stored. There is a diving compartment forward through which a diver can leave the vessel and pick up cables, mines, or counter-mines, or to establish telephone communication with fortifications on shore. There is a 5-ton drop emergency keel, which would cause the vessel to come to the surface immediately, and the keel, drop anchors, and diving chamber are said to provide absolute means of escape for the crew. We learn that the training crew has arrived from England, and the *Lake* is to be put under trial immediately.

GERMAN COURTS OF HONOR.—General von Einem recently took occasion in the Reichstag, when a discussion was raised as to duelling among officers and the maltreatment of men, to declare that the offences in both directions had been greatly reduced. On January 15 the Imperial Chancellor had stated that no officer could be tolerated in the army who was not prepared to vindicate his personal honor with his sword, and one of the leading deputies said he regarded this as a direct incitement to officers to break the law of the land. General von Einem, however, declared that the declaration of the Imperial Chancellor had been misunderstood in some quarters, and he read a fresh declaration from Prince Bülow. In 1896 Prince Hohenlohe stated that all quarrels between officers were to be submitted to a court of honor, whose decisions would be binding, and would never bear the character of compulsion to fight a duel. It would appear, however, that if this court of honor said that the honor of the officer was impugned, he would in practice be compelled to fight in vindication of it. Under the cabinet order of January, 1897, officers are compelled to submit their disputes to a court of honor, and duels on trifling grounds could perhaps hardly take place. As a matter of fact, they seem to have become rare, and the War Minister said that the Imperial order was being carried out both in the spirit and the letter. It is expressly provided that no challenge shall be accepted when the challenger acts from dishonorable motives. The Minister of War also stated that there had been a great reduction in the number of cases of the illtreatment of soldiers. During 1905, 390 individuals were punished for illtreating subordinates, being a diminution of 275 cases, and the cases of brutal illtreatment had fallen from twenty-five to six. He did not attempt to justify their occurrence at all.—*Army and Navy Gazette.*

BOOK NOTICES

"Marine Boilers." By Bertin & Robertson.

As stated in its preface this work is based on a course of lectures prepared by M. Bertin for the students at the Ecole d'application du Génié Maritime.

The translation and editing to bring the work up to date have been done by Mr. Leslie S. Robertson, Member of the Institute of Naval Architects, etc., etc.; a new chapter on "Liquid" fuel added by Ensign Lieutenant H. C. Anstey, R. N., and a highly appreciative preface written by Sir William H. White, K. C. B., F. R. S., late Director of Naval Construction and Assistant Controller, R. N.

Considering the foregoing circumstances, the reader would naturally expect a very satisfactory treatment of the subject and he will not be disappointed.

Tubular boilers are described with sufficient fullness, but very properly much more attention is given to tubulous boilers or, as we prefer to call them, water-tube boilers, giving not only details of their construction but also some interesting discussion of the principles involved in the design of the various types.

The chapter on liquid fuel gives an excellent summary of what is known and what has been done in the way of using oil for generating steam alone and in conjunction with coal, and in internal combustion engines.

The subject of forced draft is also well covered and there are other matters of interest, such as mechanical stoking, the radius of action of ships, etc., in addition to those usually treated of in text-books on boilers.

On p. 508 we note a rather remarkable statement, viz., "Pressure can be got up in tubulous boilers within one hour, while cylindrical boilers usually require four hours." "This is an advantage in the navy; but its importance should not be overestimated on account of the long operation of warming up the engines, to which not less than ten or twelve hours is given on merchant steamers in order to prevent any mishaps at starting."

It is hardly necessary to say that no such length of time as ten or twelve hours is found necessary to warm up the engines in any of our naval vessels. One or two hours, according to the size of the engines, is ample.

The work of Messrs. Bertin & Robertson, as a whole, makes an excellent supplement to the text-book on boilers used at the U. S. Naval Academy. A copy should be found in every ship library and read by every line officer in the navy who wishes to keep posted in his profession.

W. F. W.

(D. Van Nostrand Co.)

"The Soldiers Score Book for the U. S., Magazine Rifle, Model 1903," designed and arranged by Capt. E. T. Conley, 8th U. S. Infantry.

This is the best and most complete rifle score book that has come to our notice, and will, in our opinion, fill a long-felt want of the military marksman. While more especially designed for the army and national guard, it is, nevertheless, better suited for navy riflemen than any other score book which has yet appeared. To all firing under the army firing regulations and especially to those firing in preparation for the national and other matches, it will be invaluable.

(Franklin Hudson Pub. Co., Kansas City, Mo. Price, 30 cents postpaid.)

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U.S.N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U.S.N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U.S.N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U.S.N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U.S.N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U.S.N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U.S.N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U.S.N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U.S.N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U.S.N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U.S.N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U.S.N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U.S.N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U.S.N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U.S.N.I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U.S.N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U.S.N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U.S.N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U.S.N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U.S.N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U.S.N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U.S.N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U.S.N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U.S.N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U.S.N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U.S.N.

1904.

The Fleet and its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL, AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-third year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from Officers of the Army Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

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